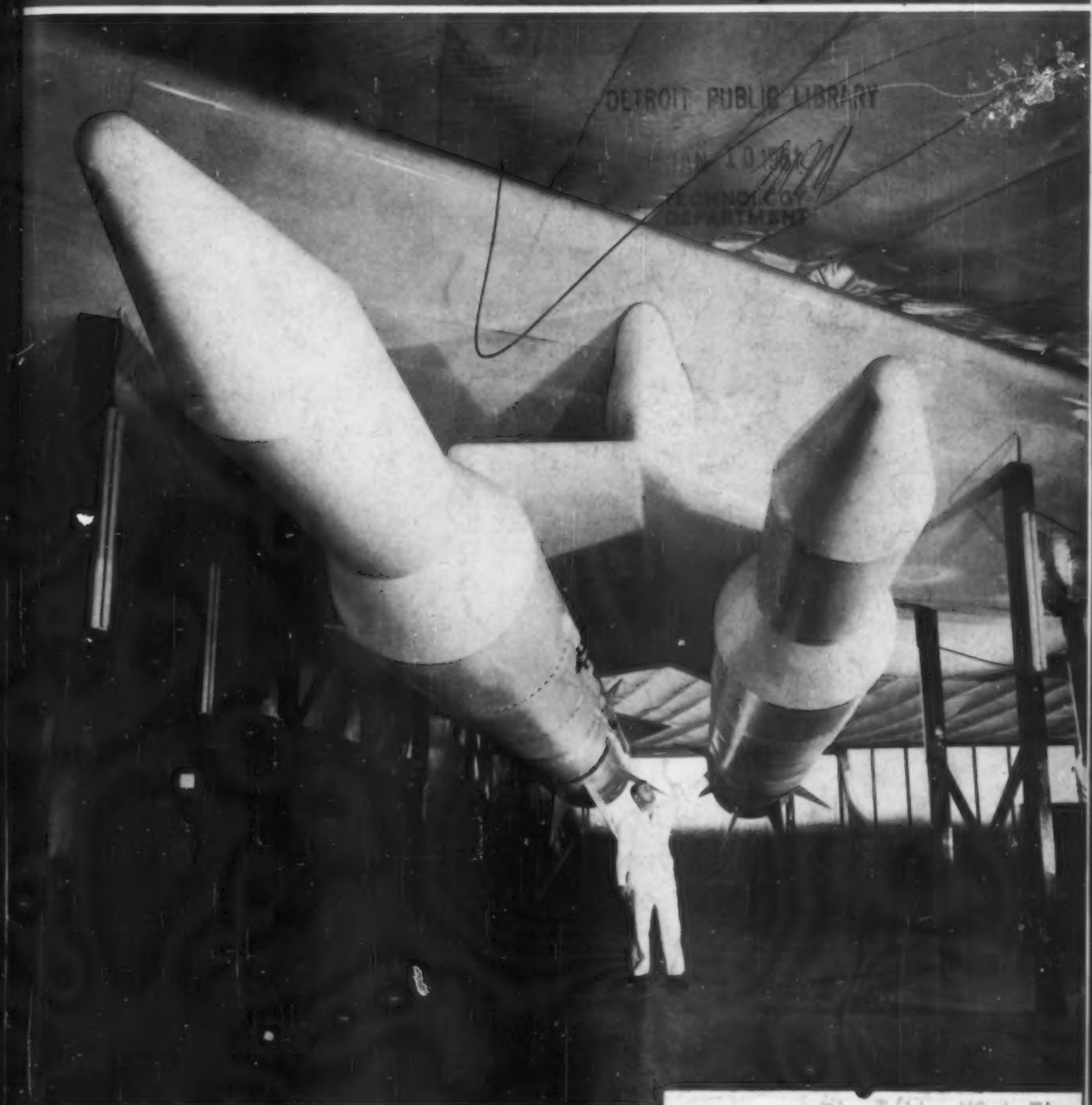
JANUARY 9, 1961

nissiles and rockets

HE MISSILE/SPACE WEEKLY

DETROIT PUBLIC LIBRARY
TECHNOLOGY DEPARTMENT



olts on B-52 Mockup

Pressing Kennedy for Big Space Role ... 11
mmercial Space Communications Nearer 13
aris 'Fail-Safe' Launching System 23

DETROIT PUBLIC LIBRARY
TECHNOLOGY DEPARTMENT PER
96 WEST PUTNAM AVE
DETROIT 2 MICH
12-1-ON 11/2 14

AN AMERICAN AVIATION PUBLICATION

Monsanto

Space-Age Project "RELIABLE"

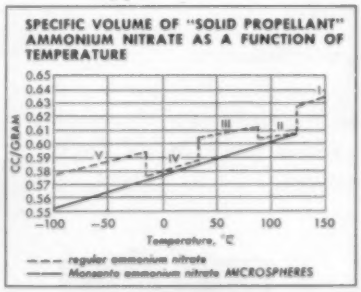
A CHEMICAL EXPEDITION

probing the chemistry of nitrogen compounds ...develops new oxidizers that improve the efficiency and reliability of solid propellants

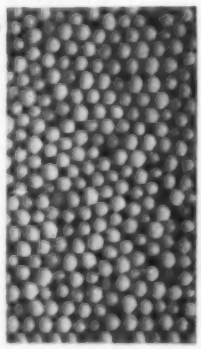
Monsanto has developed "MICROSPHERES"—a new unique form of nitrate oxidizer that gives greater packing density, a more predictable burning pattern, and greater reliability to solid propellants. Most important, the oxidizer is low-cost, heat-stable, and forestalls cracking of the grain as the propellant mass burns.

By applying advanced technology in physical chemistry to the problems of nitrate oxidizers, Monsanto has developed ammonium nitrate MICROSPHERES for solid rocket propellants. MICROSPHERES have a lower coefficient of expansion and a *linear* expansion with heat to prevent cracking of the "grain" upon temperature change. This oxidizing system is outstanding for improving reliability of production-line low- and medium-thrust solid propellants.

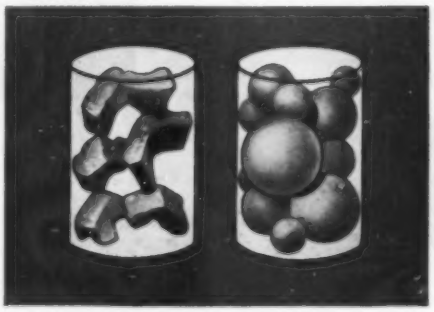
A



B



C



In contrast to high costs and handling hazards associated with other oxidizers, ammonium nitrate MICROSPHERES offer economy and safety. The new physical form increases the efficiency of the thrust and provides mechanical stability during manufacture, storage and burning.

Ammonium nitrate MICROSPHERES are an entirely new oxidizing entity for compounding solid propellants. Unlike ordinary ammonium nitrate, MICROSPHERES do not undergo expansion and contraction from crystalline phase changes, even with operational variation in temperature. (See Graph A.)

The MICROSPHERES make it possible to obtain a higher oxidizer loading for greater propellant efficiency. They are extremely dense. Small, round, and compact—MICROSPHERE particles each contain the greatest mass of chemical energy *per unit* of ammonium nitrate volume. (See Photo B.)

Tightly "packable"—the MICROSPHERES can provide the highest mass of chemical energy *per total volume* because graded sizes give the maximum density packing pattern. Even at a compound density of 1.72 grams per cc., ammonium nitrate MICROSPHERES can provide a *higher packing density* in the grain than commercial ammonium perchlorate at 1.95 grams per cc.!

Diagram C shows why and how MICROSPHERES pack to maximum density. On the left, approximately 34% void space results from using a five mode distribution of irregular-shaped oxidizer particles. On the right, only 15% void space remains with a five mode distribution of regular-shaped MICROSPHERES.

The volume relationship between round MICROSPHERES and irregular-shaped particles in mixed sizes remains approximately the same, regardless of the number of size ranges. Graded MICROSPHERE particle sizes, available in size distribution ranges that peak at 50, 200, and 300 mesh, offer maximum flexibility in controlling packing density. They effectively reduce volume to the minimum.

(*Please turn page.*)

With MICROSPHERES, less binder can be used to obtain better, more-reliable mechanical properties at a higher oxidizer loading. Unlike irregularly shaped particles, their smooth spherical shape does not cause areas of stress under "shaping" or burning deformation. They give better binder-to-oxidizer contact. With minimum plane-to-plane contact between particles, they greatly reduce the incidence of weak spots, cracking, and poor mechanical properties.

As a propellant oxidizer, ammonium nitrate MICROSPHERES offer many other benefits: good storage stability, safety from shock and thermal decomposition, uniform burning rate, smokeless exhaust, and low cost. Mixing of composite propellants is easier because their spherical shape reduces mass viscosity. They usually cut processing time and power input. MICROSPHERE grains are also easier to extrude or cast into the required geometric shapes.

NEW OXIDIZERS FOR ROCKET PROPELLANTS

...a chemical capability of Monsanto

Project "Reliable"—which produced ammonium nitrate MICROSPHERES—is actively investigating other oxidizers for rocket propellants. Monsanto chemical "expeditions" are exploring nitrogen oxides, nitric acid, ammonium salts, and other nitrogen compounds. If you work with propellants, perhaps the materials you need for *your* project can be developed by Monsanto. Write or call: Monsanto Chemical Company, Department MR, C Building, St. Louis 66, Missouri.

Monsanto 'Space-Age' Chemistry for Government and Industry

* High-Temperature Hydraulic Fluids
* Coolant-Dielectrics for Electronic Equipment
* High-Temperature Plastics
* Improved Nitrogen Oxidizers for Solid Propellants
* Fire-Resistant Structural Plastics
* Hydrocarbon Fuels for Jets and Missiles
* Fire-Resistant Hydraulic Fluids for Ground-Support and Missile-Launching Equipment
* Radiation-Resistant Heat-Transfer Fluids
* High-Temperature Lubricants and Additives
* Radiation-Resistant Reactor Coolant-Moderators
* Intermetallic Semiconductor Materials
* Pure Silicon for Transistors, Rectifiers, Diodes
* Ultra-Fine Metal Oxides
* Heat-Resistant Resins for Laminating and Structure
* Inorganic Polymers
* High-Energy Solid Propellants

You are invited to work with Monsanto on your materials needs in the above areas of technology.

Monsanto

Circle No. 1 on Subscriber Service Card.

THE MISSILE/SPACE WEEKLY

missiles and rockets

Volume 8, No. 2 January 9, 1961

CLARKE NEWLON
Executive Editor

WILLIAM E. HOWARD
Managing Editor

James Baar .....Defense & Legislative
William Beller .....Engineering
Hal Gettings .....Electronics/GSE
Charles D. LaFond .....Electronics
Jay Holmes .....NASA
John F. Judge .....Advanced Materials
Reed Bundy .....News Editor
David Newman .....Copy Editor
James J. Haggerty ...Contributor, Industry Affairs
Dr. I. M. Levitt .....Contributor, Astrophysics
Michael Lorenzo .....Contributor, Propulsion
Dr. Albert Parry .....Contributor, Soviet Affairs
Dr. Hubertus Strughold Contributor, Space Medicine
G. V. E. Thompson, Michael Donne
Contributors, British Astronautics
Gwen Cammack, Heather David Editorial Assistants
William Martin .....Art Director
Bacil Guiley .....Assistant Art Director

BUREAUS
LOS ANGELES .....8929 Wilshire Boulevard
William J. Coughlin, Bureau Chief
Frank G. McGuire .....Propulsion
Richard van Osten
NEW YORK .....20 East 46th Street
PARIS .....11 Rue Condorcet
Jean-Marie Riche
GENEVA .....10 Rue Grenus
Anthony Vandyk

EDITORIAL ADVISORY BOARD
Dr. Peter Castruccio — Dr. Arthur Kantrowitz
Conrad H. Hoeppner — Dr. Eugen Saenger
Richard F. Gompertz — Robert P. Haviland
Alexander Satin — Vice Adm. Harry Sanders (ret.)

•

Edward D. Muhlfeld
Publisher

Paul B. Kinney .....Eastern Advertising Manager
James W. Clear ....Western Advertising Manager
Don Fullam .....Sales Promotion Manager
Patricia Behling .....Promotion Assistant
Eugene White .....Circulation Manager
John F. Walen .....Production Manager
Elsie Gray .....Advertising Service Manager
Barbara Barnett .....Production Assistant

Published each Monday with the exception of the last Monday in December by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Cable Address: AMERAV.

Wayne W. Parrish
President

Leonard A. Eiserer
Exec. Vice President and General Manager

Fred S. Hunter
Vice Pres. and Editorial Director

Richard Gibson
Director of Marketing

John N. Carlin
Director of Circulation

Printed at the Telegraph Press, Harrisburg, Pa. Second Class postage paid at Washington, D.C. and at additional mailing offices. Copyright 1961, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal Union nations—1 year, $5.00; 2 years, $8.00; 3 years, $10. Foreign—1 year, $10.00; 2 years, $18.00; 3 years, $26.00. Single Copy rate—$.50 Subscriptions are solicited only from persons with identifiable commercial or professional interests in the missile/space industry. Subscription orders and changes of address should be referred to Circulation Fulfillment Mgr. M/R, 1001 Vermont Ave., N.W., Washington 5, D.C. Please allow 4 weeks for change to become effective and enclose recent address label if possible.

THE COVER

Full Scale models of the Air Force's Skybolt ALBM were shown for the first time last week on a B-52 wing mockup at Boeing's Wichita plant. (AF photo)

JANUARY 9 HEADLINES

AF Drives for Big Space Role 11
How New AF Chief Plans to Push Decisions 12
Commercial Satellite Given Go-Ahead 13
NASA Lists 36 Major Space Shots for 1961 14
NASA Stretches Out Space Program 15
'Private Ocean' for Polaris 16
Solar Flares Pose Shielding Problem 18
Engineers Have 'Inferior' Feeling 34
Hoegh Disputes Military CD 'Takeover' 40

ELECTRONICS

SLAG Makes Polaris Firings 'Fail-Safe' 23
IBM's New Cryogenic Memory Planes 25
Autonetics Unveils Minuteman Computer 29

ASW ENGINEERING

Seismology Takes to Undersea Warfare 28

ADVANCED MATERIALS

High Temperatures Foiled by Foam 30
Huge Press to Make Record Forgings 32

PROPULSION ENGINEERING

Supersonic Burning Probed 33

INTERNATIONAL

Swedes Develop Versatile Air Rocket 36
Radar Sighting System Unveiled 37

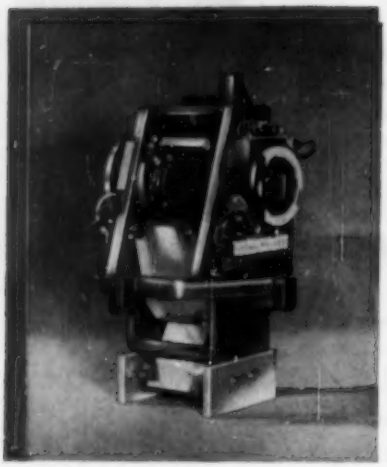
DEPARTMENTS

The Missile/Space Week† 6
The Countdown 9
Technical Countdown . 21
Industry 38
Products & Processes .. 42
Contracts 46
Names in the News ... 47
Letters 40
When and Where 49
Editorial 50

†U.S. Reg. Pdg.

32,370 copies this issue

PRECISE STAR TRACKER



A celestial navigation system called for a tracking device capable of establishing a line of position within an accuracy of 300 feet. Kollmorgen came up with a constant deviation elevation system that positions a movable mirror, in relation to the fixed elements, to a repeatable accuracy of better than 5 parts in a million.

This compact package represents a combination of highly precise optical and electronic units in a housing only 6 x 6 x 10 inches. Kollmorgen's project from concept to installation, it is a typical demonstration of the company's scientific, engineering and manufacturing skills in optics, electronics, mechanics. Example: the precision optics (a prism and two mirrors) are of Kollmorgen manufacture. So, too, are the Inland torque motor*, the gearing and other precision-machined parts.

Our motive in this message: Kollmorgen offers proven capabilities in optics, electronics and precision machining of metal components . . . capabilities which could solve your problems in missile tracking, fire controls, navigation, or . . .?

Present us with a problem.

*Product of Inland Motor Corporation of Virginia, a Kollmorgen subsidiary.

Dept. 6-1

KOLLMORGEN CORPORATION
NORTHAMPTON, MASSACHUSETTS

Circle No. 8 on Subscriber Service Card.

The Missile/Space Week

Titan II Funding Investigation Coming

A new "who struck John" fight is brewing over alleged delays in the scheduled deployment of the Martin *Titan II*.

The General Accounting Office is charging in a secret report to Congress that apparently unjustified withholding of funds will delay deployment of the storable-propellant *Titan II* five months.

However, Pentagon sources indicate that funds were withheld because of R&D problems and indecision about whether to move *Atlases* instead of *Titans*.

The first *Titan I* squadron is scheduled to be operational this summer. The first *Titan II* squadron has been scheduled to be operational by early 1963. The GAO report was sent to several House and Senate Committees. More is expected to be heard of the matter shortly.

Red Space Spectacular for Kennedy Inauguration?

Informed scientific guesstimates in London schedule a new Soviet space launching to coincide with the inauguration of President-elect Kennedy.

News reports quote "western intelligence" as indicating that the Russians will either land a robot laboratory on the moon or launch a manned spacecraft into orbit around the earth. Unusual activity is reported to be taking place at Red satellite launching pads. Moreover, Russian range ships are reported to be preparing to put to sea.

Meantime, for the record, Tass boasted as the New Year began that *Lunik I* has travelled one billion miles since it was launched into a solar orbit on Jan. 2, 1959.

Polaris: 32 Birds on Station

The Navy began the New Year with two *Polaris*-launching submarines somewhere in the sea within striking distance of the Soviet Union. Three more *Polaris* subs are scheduled to join them on station before the year is out.

The deployment of the Patrick Henry—second of the *Polaris* fleet—on Dec. 30 from Charleston, S.C., brought to 32 the number of 1200-mile range Lockheed *Polarises* in the nation's strategic forces. The first *Polaris* sub—the George Washington—sailed Nov. 15.

The Navy had pledged earlier that both ships would be on station by the end of December.

Telescope To Observe Stars from Fringe of Space

U.S. scientists are planning to photograph the heavens with a balloon-carried telescope capable of distinguishing two oranges a foot apart at a distance of 500 miles.

The 36-inch telescope is scheduled to be launched 15 miles above the earth next fall—a forerunner of the first orbiting space observatory. The telescope system weighs 4300 pounds.

Scientists hope to obtain the first photos of the clouded surface of Venus along with data that will explain the birth of stars. The project—called Stratoscope II—is under the direction of the National Science Foundation, the Navy and Princeton University.

Excess Profits Hit Eight-Year Low

The Renegotiation Board has told Congress that 1960 excess profit findings were the lowest in eight years.

The board's annual report disclosed findings of $52,708,003 in excessive profits—$15,923,346 of which were settled by mutual agreement between the government and manufacturers.

Of the board's 108 determinations of excessive profits in fiscal 1960 70 were settled with bilateral agreements. The 38 others, resulting in orders for refunds, included five airframe manufacturers with renegotiable sales of $3,102,000.

The board issued claims of $20,400,000 in excess profits against the five companies who have appealed their cases to the Tax Court. Claims against the aircraft firms represented 55.6% of the dollar volume represented in the unsettled 1960 cases, the board said.

From fiscal 1953 through 1960 the board made total refund claims of $836,520,934. In addition, voluntary refunds and price reduction by contractors amounted to $1,111,675,277. Allowing for the tax credit, the net recovery to the government is $742,500,000, the board said. Voluntary price reduction in fiscal 1960 alone reached $77,812,876.

Of 272 unilateral orders that had been issued by the board through June 30, 1959, 85 had been appealed to the Tax Court. Another 12 were appealed in fiscal 1960, 10 of which were disposed of in the same year. Some 62 cases were still pending as of June 30, 1960, including 19 by major airframe manufacturers, 43 by others. Aggregate determination of the excess profits involved is $109,847,208.

Pershing and Zeus Hold top Contract Spots

Army contract awards to Martin for the *Pershing* missile system have put the company in the No. 2 slot on the Army's major contract list for FY 1961.

The Army and Martin this last week signed a *Pershing* contract totalling $138,489,470 running through the current fiscal year. The contract represented $76,921,772 in new money. Martin already had received $61,567,698 in previous awards for *Pershing* for FY '61.

The only bigger contract awarded so far this year by the Army was to Western Electric last September for *Nike Zeus*. That came to $199,125,000.

Please Don't Tell the Kremlin

The Air Force is asking contractors not to reveal the precise locations of *Minuteman* launching sites.

"We've been criticized too much for revealing the exact locations of missile launchers," a spokesman said this last week.

However, he did not make any suggestions of how contractors were supposed to hide the holes in the ground.

Davy Crockett Takes a Bow

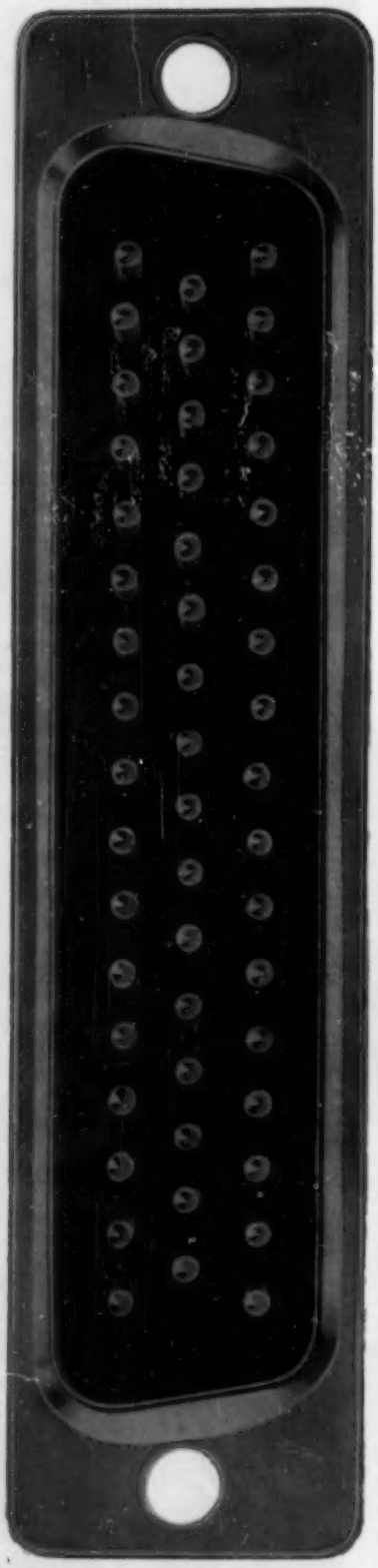
The Army this last week showed off its previously highly-secret *Davy Crockett* nuclear warhead.

It looked for all the world like a miniature model of the 10,000-pound "Fat Man" atomic bomb that was dropped on Nagasaki more than 15 years ago.

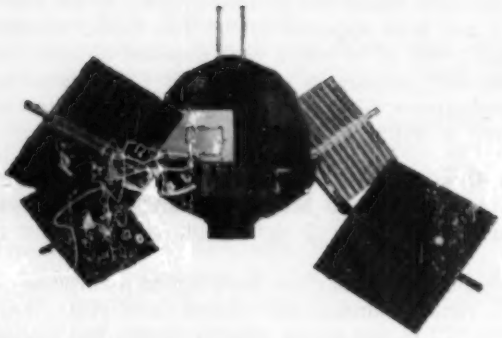
Unlike the "Fat Man," *Davey Crockett* is light enough for one man to carry it under his arm. However, in the words of Army Secretary Bruckner, it "dwarfs in firepower anything we have ever known in the immediate area of the battleline." An Army statement said *Crockett* "gives small units of firepower heretofore obtained only from massed artillery."

Crockett can be fired from jeep-mounted or man-mounted launchers that provide a wide variety of ranges. The same warhead is used for both launching systems. *Davy Crockett* is manufactured at the Army's Rock Island Arsenal. The new missiles are expected to be deployed by summer.

Circle No. 9 on Subscriber Service Card.



THREE AND ONE-HALF TIMES ACTUAL SIZE.



CANNON GOLDEN-D SUBMINIATURE PLUGS

DESIGNED ESPECIALLY FOR MISSILE CIRCUITRY AND MAXIMUM RELIABILITY APPLICATIONS

The "Golden-D" Cannon Plugs are engineered to deliver superior performance in a subminiature size! Supplementing our famous standard D-Subminiature line, the "Golden-D" has these new design features: • MONOBLOC INSULATORS • PROBE-PROOF CLOSED-ENTRY SOCKET CONTACTS • LOW ENGAGEMENT/SEPARATION FORCES • GOLDEN CADMIUM SHELL FINISH • MATES WITH ANY CANNON "D" OF SAME SIZE AND LAYOUT. Wherever maximum reliability is needed in a subminiature multi-contact plug—for both military and industrial applications—ask for the new "Golden-D"...another reason why you should contact the world's most experienced plug manufacturer for *all* your plug requirements. The "Golden-D" is available in four types with a large variety of contact layouts. For further information write to:

CANNON PLUGS

CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

The Countdown

WASHINGTON

Will Congress Count Missiles or Dollars?

Congress has yet to determine how it will implement its new policy of authorizing as well as appropriating funds for the procurement of missiles and aircraft. The big question is whether to set the precedent of doing it by numbers of missiles or numbers of dollars. Many congressmen would prefer to do it by numbers of missiles to maintain tighter control.

Atlases A-coming In

COUNTDOWN hears contractors are quietly turning over to SAC a sizeable number of *Atlas* launchers. An announcement that more squadrons are operational is expected soon. At present the announced number still stands at two—one six-bird squadron at Vandenberg, the other at Warren.

A Break for Mercury

Both the House and Senate Space Committees appear to be adopting a be kind to Mercury policy—at least for the present.

The two committees tentatively are putting off taking a hard, public look at NASA's plodding man-in-space operations until the new Kennedy Administration decides what it wants to do in space.

Mobile ICBM: Technically Looks Good

Army experts close to FABMIDS—the mobile field anti-missile missile under study—say the technical problems associated with the project look easy compared to ICBM defense. The reason: FABMIDS would be used against missiles launched close enough to use their heat plumes as a target, killing them during their boost phase.

Nike-Zeus: Testing Sooner Than Expected

The official date still being given out for the full *Nike-Zeus* tests against *Atlases* launched from Vandenberg AFB is 1962. But this is the public opening performance. Some dress rehearsals are expected out in the uncrowded Pacific later this year.

Bobby Lee Returns to the Watery Pad

Third of the *Polaris* fleet—the nuclear powered submarine Robert E. Lee—is about to begin another series of underwater training launches off Cape Canaveral. Then she will undergo some final adjustments and head for her station off the Soviet heartland probably in time to relieve the Patrick Henry. (See p. 6.)

Gen. White May Stay On

There's speculation that AF Chief of Staff Thomas White may stay on for a third term. He's highly regarded by Kennedy and some members of Congress.

From the Pad

Second *Mercury-Redstone*, which will carry a chimp on a ballistic flight, is set for the week of Jan. 17. But, it's agreed that if there is any slippage the shot won't go on Jan. 20—Inauguration Day . . . NASA is set to launch S-45, an ionosphere beacon satellite resembling Explorer VIII, about Feb. 1.

INDUSTRY

Atlas G Proposed

There's support from the House Space Committee for a Convair proposal to upgrade *Atlas* into a 900,000 lb. thrust space booster. The *Atlas G* with a *Centaur* upper stage would have a 4000 lb. payload capability, be able to lift *Dyna-Soar II*. Cost of development is estimated at $85 million; time—about two years. But, there are still no firm plans to work such a booster into the space program.

Fast Tax Write-offs Backed

Look for possible favorable action by congress on a Kennedy-backed plan to give business a stimulant by reviving some form of rapid tax amortization. More than 2000 firms have already informed the Treasury that liberalized depreciation allowances would make them increase capital expenditures for expansion. Defense industry R&D facilities presumably would be included in any new legislation.

Jackets for Missiles

AF BMD is still pursuing a study of means to keep cryogenic missiles permanently loaded with fuel and oxidizer in "ready-to-fire" state. Contractor is Linde Co., and the study may involve use of refrigerated jackets (M/R, Sept. 21, 1959, p. 35).

Air to Space Guidance

Hughes Aircraft is developing an advanced version of the sidelined F-108 fighter's guidance and control system for limited use in space.

Saturn Booster Getting Ready

Static tests of the first flight model *Saturn* 1.5 million lb. thrust booster are expected to start next month. After qualification and any necessary modifications it will be shipped by barge to Cape Canaveral for first launching, expected this year.

INTERNATIONAL

Sahara Missile Range Extension

French are planning to extend their Sahara Missile Range (Colomb-Bechar) to 10,000 miles. Equipment already is on order. Some of it also will be used for the test and evaluation later this year of the NATO *Hawk* anti-aircraft missile.

Blue Streak Decision Nears

Upcoming London conference on a joint European space program probably will result in a make-or-break decision on going ahead with the cancelled *Blue Streak* IRBM as a basic booster. French are cool towards *Blue Streak*, largely because no money is available. Even an offer to substitute the French Veronique for the English Black Knight as the second stage has aroused no "Vivas" in Paris. Germany's reactions to British plans may be the key to the whole idea.

To help men make decisions and exert control

The need for systems to help men make decisions and exert control over vast networks of rapid actions has created a fast-moving information technology. Accepting responsibility for instructing great computers, exploring system roles of men and machines, advancing system research – these are some of System Development Corporation's public interest functions in this new technology. ▪ *SDC's contributions to Sage and SAC control systems have equipped us for work in world-wide communications, education and medicine, traffic and logistics – for those information systems that will shape our culture.* ▪ *Participation in those fields has produced an interdisciplinary science based in four principal skills: Programming, Engineering, Operations Research and Human Factors. Senior professionals representing these four persuasions are invited to explore participation in our rapidly expanding programs.*

System Development Corporation, Santa Monica, California, Paramus, New Jersey.

SDC

Massive campaign . . .

AF Drives For Big Space Role

Kennedy is being urged to reverse Ike; make space top card

by James Baar

The Air Force is preparing a powerful campaign to convince the new Administration and Congress that a large scale program aimed at military control of space must be started immediately.

A series of highly-classified briefings have been prepared for the new Defense officials being appointed by President-elect Kennedy. Similar briefings are ready for presentation to various committees of the House and Senate within the coming weeks.

The conclusion pointed to by all of them is that the Eisenhower Administration policy of hobbling U.S. military space efforts should be reversed. The companion conclusion is that the United States must begin spending large sums of money to implement the policy change.

Both of these conclusions run sharply counter to the forthcoming final Eisenhower defense budget which will be sent to Congress Jan. 16. However, the Kennedy Administration is expected to make radical alterations in defense spending in line with campaign promises. These would come either in a supplemental defense money bill, amendments to the FY '62 budget or both.

The strategic thinking behind the Air Force campaign for a large space role is basically that control of space is expected to be the coming top card in the East-West power struggle.

The time period when such a top card might be played would be in the late 1960's and early 1970's. However, in order to have such a card ready, work must begin now.

Air Force officials hope to begin developing offensive and defensive military space systems on a top priority basis as quickly as possible. However, one of the most vital main goals is expected to be—not a weapon—but a means of drastically cutting the cost of placing a space system in orbit.

At present, the cost of placing one pound in orbit is approximately $1000. Air Force officials want to reduce the figure to $100 or less.

As one put it: "The first fellow that can cheaply begin putting up a man and a boy with something to drop is going to be the fellow who is way out ahead."

This line of thinking may or may not lead to a spacecraft like ASP—the proposed aerospace plane that the Air Force has under consideration. The answer might be a recoverable booster or any one of a number of other proposals being advanced by the Missile/-Space Industry.

The Air Force, in pressing for a big military space program, is confronted with a series of difficult obstacles.

Cost is among the biggest. Billions would be needed over the next few years. This kind of new spending must either come out of the hide of other programs and military services or boost appreciably the defense budget.

• **AF versus NASA**—Another major problem is the present lack of appreciation of the threat.

The entire history of the Cold War is a series of U.S. responses to Russian activities. So far the Soviet military men who are conducting the Russian space program have been able to sugarcoat their activities sufficiently to avoid alarming too many Americans unduly. If Laika had worn a sidearm, the entire U.S. space operation to date probably would have been different.

The third major obstacle is the effect of the repeated insistence by the Eisenhower Administration that U.S. policy is to explore space for peaceful purposes coupled with repeated statements that the military has a narrow mission in space at the most. It is well known that these policies have been implemented by the generous deletion by Eisenhower Administration officials of references to military space operations in Pentagon speeches.

As a result of these policies, the major space assignment was given to NASA with limited funds to support it. To meet this assignment NASA has created a sizeable coast-to-coast organization in anticipation of large scale future operations. However, if the Air Force launches a large scale space program, many of the programs planned by NASA would become duplication.

Thus, in the tradition of established government, many NASA officials and supporters can be expected to oppose the attempted entry of military programs into the field.

The strategic space threat to the United States as seen by many military men has its roots in the classic military struggle for access to the enemy's territory.

Control of space would give the Soviet Union access to any point on earth. Conversely, control of space could give the same great advantage to the United States.

Great strides toward developing manned military space systems have already been made by the Soviet Union. The launching into orbit of a five-ton manned Soviet spacecraft has been considered imminent for several months. Some reports have indicated that the Soviet spacecraft will be a winged vehicle somewhat similar to the Air Force's *Dyna-Soar*—a program still in the early R&D stage and far from liberally funded.

The Russians long ago disclosed their timetable: They plan to be on the moon by October, 1967.

Few U.S. rocket experts have expressed doubts that the Russians can be there on time.

← Circle No. 3 on Subscriber Service Card.

How New AF Chief Plans to Push Decisions

Secretary Zuckert . . .
readies himself for fast transition

by Clarke Newlon

A FAST TRANSITION into the technological intricacies of the military space age will be the major task confronting Eugene C. Zuckert when he is sworn in as Secretary of the Air Force.

The Washington attorney served as assistant secretary of the USAF from 1947 to 1952. From 1952 to 1954 he was an Atomic Energy Commissioner. In the six intervening years the world has moved a long way over the threshhold of military space operations.

In preparation for this transition Zuckert last week began a series of intense briefings to bring himself up to date. Early in the week he spent time at the Pentagon where he heard presentations by Under Secretary Joseph Charyk and teams of the Air Council.

Thursday he was to leave on an indoctrination tour which would include visits to Wright-Patterson Air Force Base, Air Force Procurement Center; Strategic Air Command Headquarters at Omaha and the Ballistic Missile Division at Los Angeles. On route he will stop at North American Air Defense Command and the Air Academy at Colorado Springs.

After his return he will spend a day each at Tactical Air Command Headquarters, Langley AFB, and at the Air Research and Development Command, Andrews AFB.

• **New positions**—Many of Zuckert's plans for the personnel of the top Air Force civilian office are already made.

Dr. Charyk will remain as under secretary and will double as assistant for research and development, with a wider scope of operations and responsibility.

Lyle S. Garlock will remain on as assistant secretary for financial management.

Max Golden will remain as General Counsel.

John J. McLaughlin will continue as administrative assistant, a post he has held through all AF Secretaries.

An assistant secretary for procurement will be named. Air Force procurement, Zuckert believes, is one of the service's vital departments and he is seeking a strong man for this post—a man he has been unable to find.

Two other special assistants will be appointed. One is for installations. Two men are under consideration for this spot.

The second is to be special assistant for public affairs, a new office created to assist Zuckert with his responsibilities for the Air Force Office of Legislative Liaison and the Office of Public Information, both headed by major generals. Zuckert has selected the man for this job but does not wish to make an announcement until after the inauguration.

Realizing that during the first six months, much of his time will be taken up with appearances on Capitol Hill, Zuckert plans to lean heavily on his assistants. Particularly is this true of Charyk and the other holdovers.

• **Making decisions**—He plans to transpose the many problems confronting the office into projects, with project officers responsible for fast solutions and decisions.

One of the points President-elect John Kennedy made during his campaign in reply to M/R's Open Letter (M/R Oct. 3, 1960) was the necessity of restoring decision-making to defense and space problems.

Like his big boss, Gene Zuckert is acutely conscious of the need for taking action. He would prefer that he and his subordinates make mistakes occasionally than that they delay decisions for fear of not being absolutely right.

Two key jobs on his personal staff which Zuckert must fill are those of legislative liaison and public information. The legislative chief is Maj. Gen. Thomas C. Musgrave and chief of information is Maj. Gen. Arno Luehman.

Musgrave has held his post since September, 1959, and Luehman since May, 1957. Both are expected to continue until early summer when the present term of Gen. Thomas White, AF Chief of Staff ends. At that time Musgrave may stay on but Luehman, after four years, will probably be reassigned.

The second term of White as Chief of Staff ends June 30 and at this time a selection must be made to fill both this place and the job of vice chief, presently held by Gen. Curtis LeMay. While the Chief of Staff is a presidential appointment, the Air Force Secretary will certainly have a large voice in the appointment.

In the Air Force four-star ranks are Generals LeMay, Laurence Kuter, Thomas Power, Frederic Smith, Frank Everest, Samuel Anderson, Emmett O'Donnell and Lauris Norstad. Any might be named, with the probable exception of Norstad who has been in ill health and wishes to retire. There is also the possibility of dipping down into the three-star rank. ⠿

White House Order . . .

Commercial Satellite Given Go-Ahead

NASA to start R&D on active-repeater communications satellite; FCC preparing to grant experimental channels temporarily to AT&T

by Jay Holmes

COMMERCIAL COMMUNICATIONS satellites are moving closer to reality on two fronts.

President Eisenhower ordered the National Aeronautics and Space Administration last week to take the lead in the Executive Branch of government to carry out R&D and to encourage private industry to apply its resources toward the earliest practical use of space technology for commercial communications.

NASA promptly arranged for a two-day industry briefing at which it will ask for bids on developing a real-time active repeater satellite for flight within two years.

Meanwhile, the Federal Communications Commission prepared to award the American Telephone & Telegraph Co. temporary licenses to operate transmitters on the ground and on a satellite for experiments in long-range communications.

The President said NASA will cooperate closely with FCC to make sure that high communications standards are maintained in using satellites. He called for concerted action and funding on the part of both government and private enterprise in this country and communications organizations in other countries.

James C. Hagerty, Eisenhower's press secretary, was asked what effect the change of administration would have on the policy statement by the President. Hagerty replied that Eisenhower's executive order will stand as the policy of the government unless and until changed. He said there had been no consultation on the subject with the incoming Kennedy administration. Dr. Hugh L. Dryden, deputy NASA administrator, added, however, that the congressional space committees were informed.

• 20 companies involved—It is understood that the new administration will review the Eisenhower policy statement along with its planned complete review of the nation's space program. However, there does not appear to be any wide-spread sentiment for immediate modification. Space advisers to the new administration are convinced as much as the old administration that operation of commercial communications facilities must remain in private hands.

COMMUNICATIONS SATELLITE developed by Hughes for 24-hour orbit weighs 32 lbs.

Twenty companies will be invited to the briefing to be held by NASA's Goddard Space Flight Center, Greenbelt, Md. They are AT&T, Lockheed Missiles and Space Division, Ford Aeronutronics Division, Republic Aviation, Avco Research and Advanced Development Division, Western Electric Radio Division, International Telephone & Telegraph Corp. Federal Division, Bendix Systems Divisions, Hughes Aircraft, Motorola, RCA Astro-Electronic Products Division, the Martin Co., Collins Radio, General Dynamics' Convair Division, Page Communications Division of Northrup Corp., North American Missile Division, Grumman Aircraft, McDonnell Aircraft and Loral Electronics.

Goddard tried to set the briefing for Jan. 4 and 5, but specifications could not be prepared in time. It is expected to be held this week or next.

Dryden said NASA wants to develop real-time active repeater satellites weighing 100 lbs., using solar power, which would be launched into orbits varying in altitude from 3000 to 6000 miles. He said such a satellite, using an omnidirectional antenna, would need no attitude controls. A system of 25 to 40 satellites would provide complete coverage for 600 telephone channels or one television channel.

The first satellite could be launched in 18 months to two years by a *Delta* vehicle, Dryden continued, but multiple launchings would be necessary to bring down the cost of the satellite system. The biggest problem in R&D is the lifetime of electronic components, such as solar cells, in space. He recalled that the Army's *Courier 1B* communications satellite quit operating a few days after launching last Oct. 4.

For comparison, the NASA official also outlined the characteristics of two other communication satellite systems under active development, the *Echo*-type low-altitude passive communications satellite, being developed by NASA, and the synchronous 24-hour active repeater satellite, being developed by the Department of Defense under Project *Advent*.

• Quick Echo—The next *Echo* will have a 140-ft. diameter, weigh 600 lbs., and will be launched to an altitude of 1500 to 2000 miles. A world wide system of *Echo* satellites would require 60 to 100 of them, distributed in several planes at random. To lengthen the satellites' life, the skin must be stiffened somewhat.

Dryden believes an *Echo*-type system can be achieved very quickly but its utility will be limited because of the

narrow channel width—wide enough for voice, telegraph and transmission of still pictures, but not wide enough for telegraph.

The 24-hour satellite might weigh 1200 lbs., be powered by solar cells and travel in a circular equatorial orbit of 22,300 miles altitude. It would require a directional antenna and attitude controls, to keep the antenna pointed toward the earth. A system of three satellites would provide from one to four television channels or an equivalent bandwidth for voice and telegraph channels.

Dryden said the 24-hour satellite characteristics were the result of a NASA study. He emphasized that they are not necessarily the exact characteristics of the *Advent* satellites.

Robert G. Nunn Jr., NASA assistant general counsel who has been specializing in communications problems, said one TV channel requires 4½ to 5 megacycles bandwidth and equals 600 voice channels. A voice channel is about equal to 20 telegraph channels.

Hagerty, who is expected to join the American Broadcasting Company after Jan. 20, predicted that if communications satellites R&D is pressed, it will be possible to receive live TV coverage from the 1964 Olympic Games in Japan. Dryden estimated that a system of satellites and ground stations would cost $60 million to $100 million to establish. He said this is about half the cost of laying underwater cables with the same capacity.

The major economic problem for communications satellites will be similar to that of operating jet airliners, Dryden declared. The full capacity must be used. Eisenhower, in his statement, said the world's requirements for communication facilities will increase several fold during the next decade.

• **Some opposition**—The AT&T application before the FCC asks for permission to construct a 3000-watt station that would transmit to the satellite from Holmdel, N.J., in the 6775-6875 megacycle band and a 5-watt transmitter that would operate aboard the satellite in the 6425-6525 megacycle band. The company said it expects to complete construction within eight months after grant of permission to proceed.

FCC sources indicated that the application was being worked on very actively late last week and a decision could be expected at any time. Neither hearings nor meetings of the full commission are necessary for action on requests for experimental stations.

Some opposition to the request has been put before the FCC but indications are that the license will be granted nevertheless. At the White House press conference, Dryden said he understood the FCC viewed the application favorably.

The opposition may be heeded, however, with respect to the AT&T request that the entire 6425-6925 megacycle band be set aside for satellite communications. The latter request has drawn opposition from 10 organizations representing companies interested in developing private point-to-point microwave communication systems. All suggested that the FCC defer consideration of the request until it takes up its long-range study of frequency requirements for space and earth-space communications, for which interested parties are to reply by March 1.

Opposition to the AT&T application was filed by American Waterways Operators Inc., Forest Industries Radio Communications, Electronic Industries Assn., American Petroleum Institute, National Retail Merchants Assn., Aeronautical Radio Inc., Assn. of American Railroads, Motorola and the National Committee for Utilities Radio.

Most opponents argued against the principle of sharing frequencies between space communications users and those on the ground. They suggested, instead, that channels for space communications be taken from those already allocated to common carriers, such as the 5925-6525 megacycle band.

AT&T replied that sharing between space communication systems and the long-distance common carrier services of bands such as 3700-4200 mc and 5925-6425 mc "would result in the imposition of limitations in the use and capacities of these microwave radio systems," used for long-distance telephone service. ⌗

1961 Launches

NASA Schedule Lists 36 Major Space Shots

The National Aeronautics and Space Administration plans 36 major launches in 1961, beginning with a chimpanzee-carrying *Mercury Redstone 2* this month.

The year's schedule calls for 16 *Mercury* shots, 14 unmanned satellites, 5 space probes and first launching of the mighty *Saturn* booster.

In the *Mercury* schedule are one *Little Joe*, six *Redstone* and nine *Atlas* launchings, of which six or seven will be attempts at orbit. The number of empty capsules launched into orbit, followed by capsules carrying chimpanzees, will depend on developments. The timing and sequence of the first manned shot is of course even more conjectural.

Unmanned satellite shots include three *Juno II's*, winding up that program, five *Deltas*, three *Scouts* and three *Centaurs*, aiming at 24-hour orbits. The most interesting satellites are *S-16*, the *Orbiting Solar Observatory*, to be launched by a *Delta* vehicle in the second quarter; the third *Tiros*, to be launched by a *Delta* in the third quarter, and *S-15*, the gamma ray astronomy satellite, to be launched by a *Juno II* in the first quarter.

Space probes include *P-14*, a magnetometer experiment to be launched by a *Delta* in the first quarter, *P-32* and *P-33*, the first two *Ranger* spacecraft tests, to be launched by *Atlas-Agena B* vehicles in the final two quarters, and *P-21* and *P-21a*, a pair of electron density experiments to be launched by *Scouts* in the third and fourth quarters.

Here is the tentative schedule:

First quarter

Mercury MR-2, bearing a chimpanzee; January
Ionosphere beacon S-45, Juno II
Mercury MA-2
Little Joe 6 (repeat of LJ-5)
Interplanetary P-14, Delta 4
Mercury MR-3 (manned if MR-2 goes well)
Mercury MA-3
Air density drag S-56, Scout 4 (repeat of Scout 3)
Mercury MA-4
Gamma ray astronomy S-15, Juno II

Second quarter

Mercury MR-4, (presumably second manned shot)
Mercury MA-5
Orbiting Solar Observatory S-16, Delta 5
Micrometeorite S-55, Scout 5
Mercury MR-5
Backup Juno II
Mercury MA-6
Radiation belt S-3, Delta 6
Vehicle test, Centaur 1

Third quarter

Backup Scout 6
Mercury MA-7
Mercury MR-6
Electron density probe P-21, Scout 7
P-32, (Ranger 1), Atlas-Agena
Mercury MR-7
Tiros 3, Delta 7
Mercury MA-8 (this could be the manned orbital)
Vehicle test, Centaur 2
Saturn 1 (dummy 2nd and 3rd stages)

Fourth quarter

Electron density P-21a, Scout 8
Mercury MA-9
Backup Delta 8
P-33 (Ranger 2), Atlas-Agena
Mercury MA-10
Atmospheric structures S-6, Delta 9
Vehicle test Centaur 3

NASA Stretches Out Space Program

Planetary exploration is moved back to 1964—2-year delay unless Kennedy acts, Rover nuclear rocket also will slip to 1966-67 period

MAJOR STRETCHOUT of the U.S. Civilian space program has been added to the problems left with the Kennedy administration by the outgoing Eisenhower team.

Administrator T. Keith Glennan of the National Aeronautics and Space Administration ordered the stretchout and announced it together with his resignation, effective Jan. 20. While lowering the nation's sights, he said America is "once again preeminent in the conduct of research and development."

Eisenhower, in a "Dear Keith" letter, replied that under Glennan's leadership NASA has "compiled a record of achievement of which every American can be justly proud."

By late last week, Deputy Administrator Hugh L. Dryden had given no indication of his plans. It was understood that Dryden will be available to the new administrator to assist him in the transition period.

Dryden, who will be 63 on July 2, is expected to remain in government service in some capacity until he reaches the retirement age of 65. Possibilities include service with AGARD and the National Academy of Sciences, as well as staying with NASA in another capacity. He has been home secretary of the academy since 1955.

• **Delays detailed**—The Glennan stretchout affects plans for first instrumented flight to Venus, the first launching of the Orbiting Astronomical Observatory, flight test of the *Rover* nuclear-thermal rocket, flight qualification of the 1½-million-lb.-thrust F-1 engine and flights of the *Apollo* three-man spacecraft.

Glennan said the 10-year plan, first presented last year, "has recently been revised in the light of our experience during the past year." A NASA spokesman said the revisions were made within NASA and not at the White House or the Budget Bureau. Asked whether the reason was funding or technical factors, the spokesman said he assumed both came into play.

A source close to the incoming administration predicted the whole program will be reexamined after Jan. 20. "We will start with no preconceived notions," he said.

The first instrumented flight to Venus was delayed from 1962 to 1964. Last Oct. 26, R. J. Parks, director of the planetary program at NASA's Jet Propulsion Laboratory, announced plans for a Venus fly-by as the first mission of Project *Mariner* in 1962 (M/R, Jan. 2, p. 14). Under the new program a "planetary spacecraft" is to be launched in 1962, but no attempt will be made to direct it to the vicinity of Venus. Reconnaissance of both Venus and Mars was set for 1964.

Glennan delayed the first launching of the Orbiting Astronomical Observatory from 1963 to 1964. The *OAO* has been under development for three months, under contracts with Grumman and Westinghouse. NASA officials would not say whether funding or problems discovered since Oct. 10 caused the delay.

• **Studies unnecessary?**—The flight test of the nuclear rocket was moved back from 1965 to the 1966-67 time period. The change surprised observers because Harold B. Finger, chief of the joint NASA-Atomic Energy Commission Nuclear Propulsion Office, said recently that the timing and nature of the flight test would depend on the outcome of contracted studies still in progress.

Glennan set the final qualification of the F-1 engine for 1965. This was an addition to the program, since preflight qualification in 1963 was all that had been previously approved. However, it was a stretchout in the sense that engine qualification can be accomplished in as short a time as six months if there is any urgent necessity. Apparently, Glennan scheduled a leisurely qualification because he did not expect any need for the engine before that time.

The exact amount of the stretchout of the *Apollo* program was somewhat obscure. Robert R. Gilruth, director of NASA's Space Task Group, told the Goddard Space Flight Center industry briefing last Aug. 30 that *Apollo* "active flight testing and mission flights" would take place in the 1965-70 period.

Under the new schedule, only a prototype capsule test is to take place in 1965 and the manned orbital space station and circumlunar flights were set for the 1968-70 period. Apparently, the new schedule cancels plans for a prototype *Apollo* capsule flight, which had been scheduled for the eighth *Saturn* flight, in 1963.

NASA's New Long Range Plan

1961
- Suborbital manned flight
- Centaur launching
- X-ray astronomy satellite
- Orbiting Solar Observatory (OSO)
- Ranger spacecraft launching
- Orbital manned flight
- Saturn booster launching

1962
- Lunar landing, Ranger
- Topside ionosphere satellite (Canadian)
- Planetary spacecraft launching
- Nimbus meteorological satellite

1963
- Active communications satellite
- Saturn 2-stage launching
- Soft lunar landing
- Saturn 3-stage launching

1964
- Orbiting Astronomical Observatory (OAO)
- Flight qualification of 200K hydrogen engine
- Unmanned Mars or Venus flyby

1965
- Flight qualification of 1500 K F-1 engine
- Apollo prototype capsule test

1966-7
- Saturn C-2 3-stage flight
- Nuclear-thermal rocket flight test
- Lunar landing with mobile instruments.

1968-70
- Attempt at orbit of another planet
- Apollo manned flights

first photos

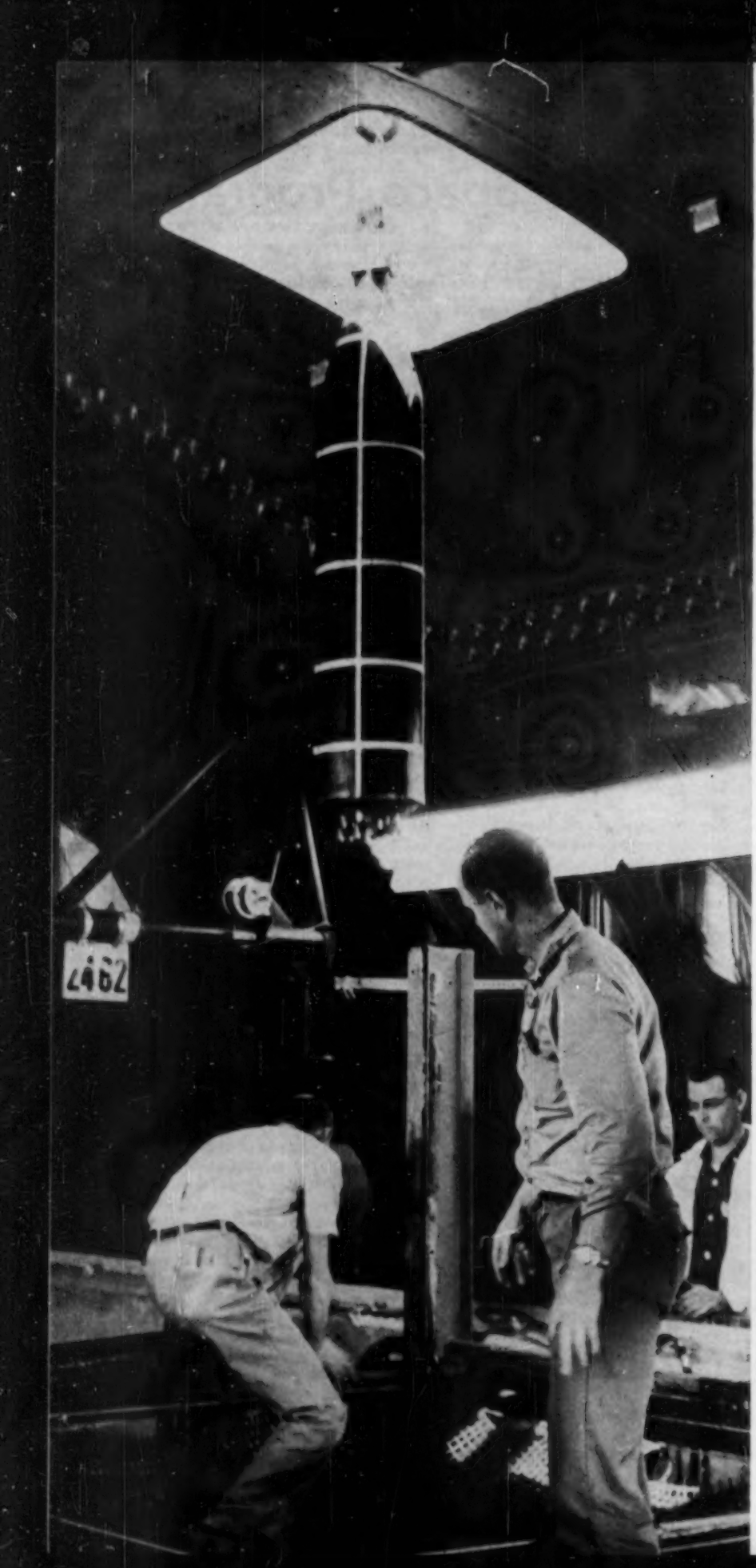
'Private Ocean

Models tested at Lockheed's LUMF saved money, proved out feasibility of missile's launch method

A PRIVATE OCEAN built to launch-test scale models of the Polaris missile has been credited with saving millions of dollars and man-hours.

Thousands of launching tests were conducted by Lockheed at its Underwater Missile Facility (LUMF) before the Polaris became operational. The tests proved feasibility of the launch method and provided vital data on the hydrodynamic performance of the missile shape under an infinite variety of launching conditions.

Encased in a cylindrical steel tank, LUMF can provide simulated conditions almost identical to those in actual submarine launchings. Waves can be produced accurately in scale up to near-



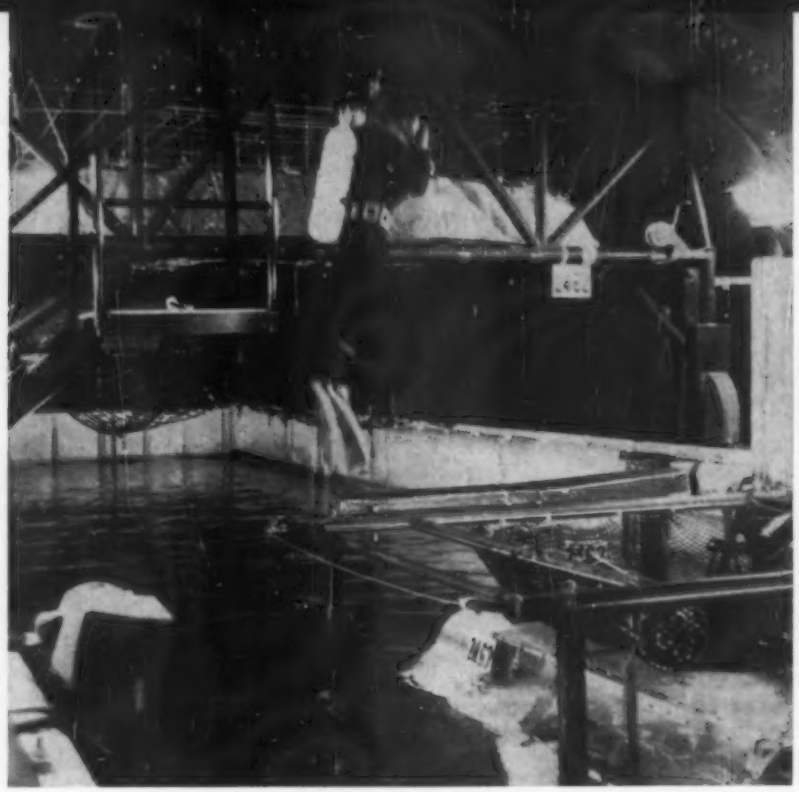
LEFT: *SMALL-SCALE Dummy Polaris missile is lowered into launching tube for under-water launching test. Missile enters through hatch in pressure hull surrounding test facility.*

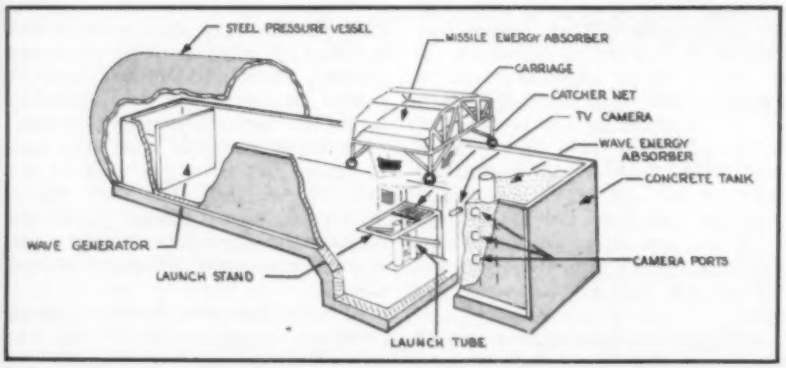
LOCKHEED UNDERWATER missile facility is encased in a pressure hull so the 85-foot long tank can be reduced in atmo-

...r Polaris

hurricane force. Internal pressure can be reduced in the tank to provide a realistic differential consistent with that encountered in full-scale operation. Pitch, roll, and forward motion can be simulated.

In test launches from the sub-scale version of the submarine's missile section, ultra-high-speed motion picture cameras record the underwater trajectory. Data from instrumentation in the missile models and in the tank is recorded on magnetic tape and oscillographic tracings in a shack near the tank. There, engineers also monitor the test by remote closed-circuit TV. ⌗





ABOVE: *SUBMERSIBLE TEST STAND (just awash in foreground) contains scaled-down Polaris launching tubes in fairing designed to simulate section of Polaris submarine hull.*

LEFT: *STEEL PRESSURE VESSEL encloses entire assembly, wave generator, launcher, catching rig, camera ports, and beach at one end which dissipates wave return.*

BELOW: *MISSILE MODELS are launched by rig, (center) immersed for tests. Remotely operated TV camera (lower left) monitors tests. Frogman assigned to the project maintains underwater equipment.*

spheric pressure to simulate differential between sea surface and submerged missile submarine.

Solar Flares Pose Weight Problem

Grumman engineers urge use of ablative materials, propellants, equipment and structure as shielding to reduce burden

NEW YORK—Shielding weighing 5000 lbs. may be required to protect one man from a solar flare equal to that of May, 1959.

Grumman engineers T. G. Barnes, E. M. Finkelman and A. L. Barazotti reported their calculations in a paper given at the Lunar Flight Symposium, sponsored by the American Astronautical Society as part of the annual meeting of the American Association for the Advancement of Science.

To reduce the dead weight of radiation shielding in spacecraft that travel beyond the Van Allen belts, the Grumman engineers proposed maximum use of ablative materials, propellants, equipment and structure as shielding. As one example, they suggested that a maximum-hazard compartment might be set up at the center of the craft, within a LOX tank.

Solar flares were broken down into two categories: the very large flares emitting protons in the very-high-energy range, of which there have been six in the last 18 years, and those discovered during the International Geophysical Year, which have particles of lower energy but much greater numbers of particles. The May, 1959, event was an example in the second category.

• **Rare events**—The IGY-type flares occur about once a month during solar maximum, which was in 1957-59. K. A. Anderson of the State University of Iowa has suggested that the frequency may fall to less than three a year at solar minimum, due in 1963-64, and that events such as May, 1959, may occur only about once a year during maximum activity periods of the solar 11-year cycle.

For a five-day, low-energy swing around the moon, they noted, the probability of encountering a major solar flare is less than 2% for a period when flares are once a year and about 16% for a period when flares come about once a month. However, with the use of a technique developed by Anderson for predicting flares two days in advance, the probabilities are reduced considerably. They said it is doubtful that the Anderson prediction method can be extended beyond four days.

Protection for manned spacecraft was calculated on the basis of facts known about solar flares of March 23, 1958, Aug. 22, 1958, and July 14, 1959, as well as the May 10, 1959, event.

Important Solar Flares

Date of Observation	Data	Observer
March 23, 1958	0.11 protons/cm-sec-ster above 120 mev (balloon)	J. R. Winckler
Aug. 22, 1958	100-570 protons/cm²-sec above 100 mev (satellite)	K. A. Anderson
May 10, 1959	1000 protons/cm²-sec above 110 mev (balloon)	J. R. Winckler
July 14, 1959	Inferred 17,600 protons/cm²-sec at 40-500 mev in space from balloon measurement	J. R. Winckler, R. R. Brown

Allowing for dose limits of 5 rem in the spacecraft design and 25 rem in case of emergency, they figured that shielding of 10 grams of carbon per sq. cm. would shield adequately against protons of the inner Van Allen belt and against flares as big as those of March and August, 1958. However, the May, 1959, flare would require 40 grams per sq. cm. of carbon. Tissue doses were calculated with the assumption of radiation biological effectiveness (RBE) of 2.0 for proton energies less than 40 mev and 1.0 for higher energies.

Using carbon shielding, they arrived at a weight of 5000 lbs. for an emergency shield for one man, a cylinder 2 ft. in diameter and 6 ft. long.

• **Geometry a factor**—The Grumman engineers reported that the choice of shield materials for minimum weight depends on geometry, as well as radiation types. For slab geometry, low atomic weight materials are best for reducing the flux of primary protons, the major element of danger to man in solar flares and the radiation belts. However, the density effect tends to favor heavier materials when curved shielding is required, and as the radius of curvature is decreased.

They chose carbon as a reasonable compromise for their calculations, because it is a good choice over a fairly wide range of radii. However, carbon has a high cross-section for producing secondary neutrons. Other possibilities discussed were lead, aluminum, beryllium and liquid hydrogen.

Although solar flares are the primary danger, calculations were also made for the radiation belts and galactic cosmic rays.

Cosmic rays—consisting of about 85% protons, 13% alpha particles and less than 2% particles of higher atomic number, all stripped of their electrons—have an energy spectrum extending up to 10^{12} mev. Fortunately, however, their flux is extremely small. The total integrated flux for a year may be less than 10 roentgens, they said. This is double the newly lowered maximum radiation allowance for industrial workers, set by the Atomic Energy Commission.

• **Safer than solar flares**—Although complete energy spectra for the Van Allen belts are not yet available, the Grumman engineers concluded that the danger is less than from major solar flares.

For example, they calculated that inner belt protons in the 20-60 mev energy range would provide incident flux of 5×10^6 protons per sq. cm., about 1/10,000 that required to damage a silicon solar cell, in an escape trajectory from a 100-mile orbit out through the polar regions. Outer belt electron intensity would be about the same proportion of that required for damage.

However, protons of 35 to 140 mev in the May, 1959, flare would have been in excess of the flux needed to do damage.

They suggested that addition of cover glass over solar cells might protect them from electrons, but not solar protons. The most promising approach, they added, is the development of radiation-resistant cells. ⌗

AEROSPACE CORPORATION

are creating a climate conducive to significant scientific achievement

"Essentially, this corporation will be people—people of the highest quality. The United States Air Force recognizes that men of great scientific and technical competence can perform at their best only when they can exercise their initiative to the full under leadership which creates the climate for creativity. We expect Aerospace Corporation to provide that kind of environment."

SECRETARY OF THE AIR FORCE

Among those providing their leadership to this new non-profit public service corporation are: Dr. Ivan A. Getting, president; Allen F. Donovan, senior vice president, technical; Jack H. Irving, vice president and general manager, systems research and planning; Edward J. Barlow, vice president and general manager, engineering division; and Dr. Chalmers W. Sherwin, vice president and general manager, laboratories division.

These scientist/administrators are now selecting the scientists and engineers who will achieve the mission of Aerospace Corporation: concentrating the full resources of modern science and technology on rapidly achieving those advances in missile/space systems indispensable to the national security.

The functions of Aerospace Corporation include responsibility for: advanced systems analysis; research and experimentation; initial systems engineering; and general technical supervision of new systems through their critical phases, on behalf of the United States Air Force.

Aerospace Corporation is already engaged in a wide variety of specific systems projects and research programs—offering scientists and engineers the opportunity to exercise their full capabilities, on assignments of unusual scope, within a stimulating environment.

Immediate opportunities exist for:

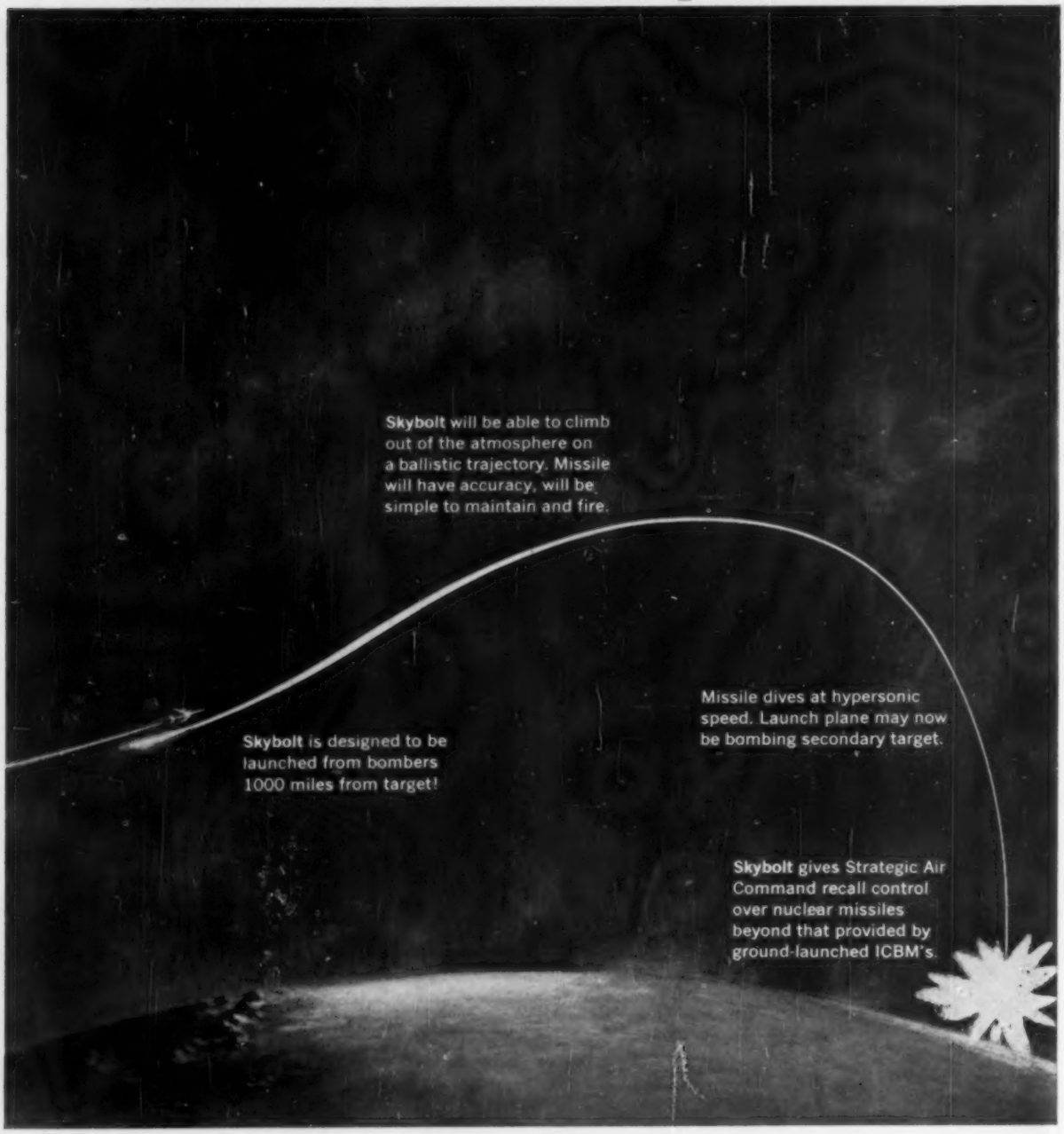
- WEAPONS SYSTEM PROJECT DIRECTOR
- SENIOR SCIENTISTS/SUPERVISORS:
  Propulsion Systems
  Guidance Systems
  Spacecraft Design
  Telecommunications
- SPACE VEHICLE SPECIALISTS:
  Senior Power Systems Engineer
  Sr. Flight Performance Analyst
  Re-entry Aerodynamicist

Those capable of contributing in these and other areas are invited to direct their resumes to:

Mr. James M. Benning, Room 105
P.O. Box 95081, Los Angeles 45, Calif.

A new and vital force AEROSPACE CORPORATION *engaged in accelerating the advancement of space science and technology*

One of a series of advertisements in the public interest to show how Douglas works with all our military services and space agencies.


Skybolt will be able to climb out of the atmosphere on a ballistic trajectory. Missile will have accuracy, will be simple to maintain and fire.
Missile dives at hypersonic speed. Launch plane may now be bombing secondary target.
Skybolt is designed to be launched from bombers 1000 miles from target!
Skybolt gives Strategic Air Command recall control over nuclear missiles beyond that provided by ground-launched ICBM's.

New Air Force Douglas Skybolt will extend role of manned aircraft in Space Age defense

Now under development, this new air-to-ground missile of nuclear capability could add years of usefulness to U.S. Air Force B-52s and the Royal Air Force Vulcan bombers. Four Skybolts can be launched from one B-52 at widely divergent targets. And since the missiles will be released as much as 1000 miles from target, the bombers carrying them will be practically invulnerable to attack.

DOUGLAS

MISSILE AND SPACE SYSTEMS • MILITARY AIRCRAFT • DC-8 JETLINERS • TRANSPORT AIRCRAFT • ANTI-SUBMARINE SYSTEMS • AIRCOMB® • GROUND SUPPORT EQUIPMENT

Technical Countdown

ELECTRONICS

Creeping Sophistication and Red Ink

Informed electronics industry spokesmen have told TECHNICAL COUNTDOWN that slowdown on numerous NASA development contracts occurs because of the space agency's penchant for "creeping sophistication." Progress becomes snarled by continual demands from NASA representatives for system modification—usually without benefit of increased funds or extended delivery dates. The end product, they say, is still behind the state of the art and delivered too late, and the contractor earns only another loss statement for his efforts.

Lunar Temperature Studies Extended

Scientists at Hughes are preparing to employ long-wavelength infrared techniques at various high-altitude locations to study lunar atmospheric characteristics and spatial background. Their current studies of lunar-surface temperature change, using reflecting optics and radiometric measuring systems, are similar to the recently reported Boeing lunar research (M/R Jan. 2, p. 39).

FCC Investigates Space Communication Needs

The Federal Communication Commission has broadened its investigation of long-range needs for radio spectrum allocations for space communications. It will also take a look at the possibility of reserving sparsely settled sites to provide earth terminals for space systems. Because of the urgency of the matter, FCC may, in addition, include some research on space communications in its inquiry.

NBS to Listen to Earth's Pulse

The Bureau of Standards will shortly begin a study of micropulsations—faint low-frequency electromagnetic waves —which exist around the world. Eight six-foot loops, each containing 130 miles of hair-like copper wire, will serve as antennas to pick up these oscillations below 20 cps. The signals are much stronger in the auroral zones and it is thought that they are associated with the influx of primary electrons into the ionosphere due to solar storms.

Time-Signal Broadcasts Changed

Standard time signals broadcast by WWV and WWVH have been retarded by 15 milliseconds to bring them into closer agreement with other standardized frequency broadcasting staitons throughout the world. In addition, the special binary coded timing signals—tried experimentally in 1960—have been put on the air by WWV on a permanent basis. The timing code will provide a basic standard for simultaneous global scientific observations such as the recording of data telemetered from satellites.

AF Initiates New Battery Study

Satellite battery life and performance data never before available is expected to come out of an Air Force (WADD) life-testing program conducted by Cook Electric. Nickel cadmium batteries will be run until failure under simulated space temperature and charge-discharge cycle conditions. The tests—to continue for more than a year—will establish expected lifetimes and failure rates for the batteries and show why they fail.

EPRA Working on Electronic Component Forecast

The first five-year forecast for military requirements of 13 different categories of electronic components is scheduled for publication next July. The Electronics Production Resources Agency forecast will cover various types of batteries, capacitors, transformers and reactors, instruments, relays, quartz crystals and filters, vacuum tubes, semiconductor devices, connectors and servo devices.

GROUND SUPPORT EQUIPMENT

JPL 250-Ft. Dish Under Study

Four study contracts have been awarded by NASA's Jet Propulsion Lab for a new over-size space-tracking antenna. The four competing companies designing the 250-foot dish are Hughes Aircraft, Blaw-Knox, Westinghouse Electric, and North American Aviation.

Reactor Instrumentation Simplified

General Electric's newly developed "neutron telescope" is an important step toward simplifying nuclear reactor instrumentation. Basically a fast neutron counter housed in a special tube, it measures small changes in steam output of selected fuel channels. It functions from a distance of 20 feet or more through six feet of water and more than two inches of steel.

ADVANCED MATERIALS

Rocket Use of Steel, Aluminum to Decline

A survey of developments in the areas of case, nozzle and insulation materials by Grand Central Rocket disclosed that steel and aluminum face a dwindling market while titanium, reinforced plastics, graphite, ceramics and cermets have bright prospects in the coming decade. Beryllium and the exotic metals will be used—but in a restricted sense, because of fabrication difficulties and high cost.

Russians Pick Up Hopkins Process

Electroslag melting of steels for tubing and bearings is under way at the Dneprospetsstal Metallurgical Plant. The Russians credit this process, which is also used in the U.S. by Firth-Sterling, with producing more weldable alloys.

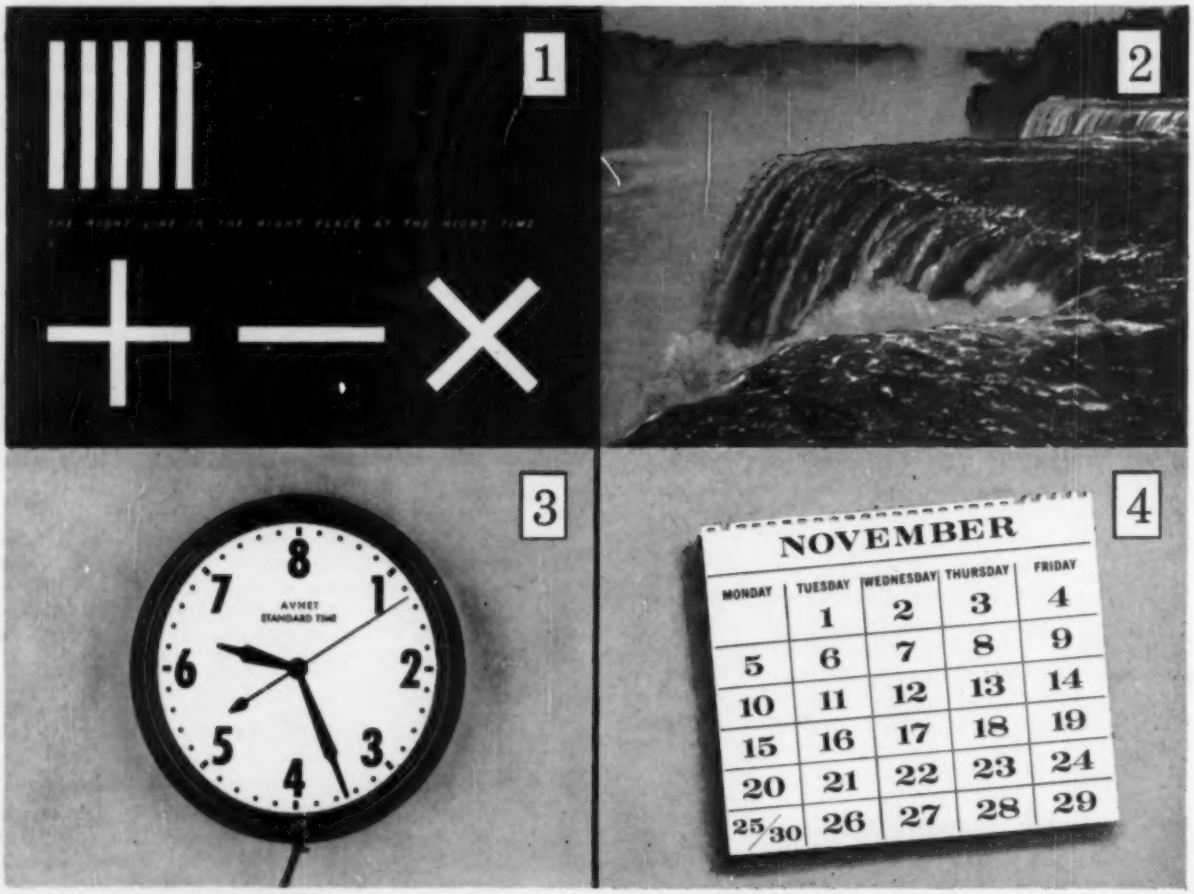
Titanium Bounces Back

Mill product shipments of titanium in 1960 hit 10 million lbs.—a 50% increase over 1959. The increase is believed to be partly due to the price competition the wonder metal is giving other, more established, engineering metals. A growing missile use of titanium also helps; this is expected to continue fairly constantly through 1961.

Machining-Information Center Established

The Metcut Research Machining Data Center, established by Metcut Research Associates, Inc., is starting to gather, correlate and develop machining information on metals, alloys and non-metallic materials. The Center expects to become a national source of such data and to provide facilities for experimental development and application of machining and machinability information.

Which of These 4 Major Improvements Is Most Important To Your Business?



The Avnet System

is based on New Concepts, Major Improvements in Service

The Avnet System *IS* a system of improvement, newness, change for the better. That's how progress is made. That's how—and why—Avnet is America's major source of supply in electronic components. Of the many new practical concepts Avnet has introduced, four are symbolized above. Which of them are important in your business?

1 A NEW CONCEPT OF PLACING the Right Line—in the Right Place—at the Right Time. The Avnet System supplies not only the components themselves but a wealth of application information, saving the user hours of costly research time.

2 A NEW CONCEPT OF SUPPLY—an available supply that is overwhelming in its size. Avnet's supply of electronic components is vast—in breadth and in depth. It is also carefully anticipated to meet your demands of tomorrow, next month, next season.

3 A NEW CONCEPT OF TIME. Avnet ships your orders about ⅓ faster than any other major source of supply, hence ⅓ of the hours can be cut from your waiting time. Although the 8 hour clock is symbolic, it is symbolic of a fact.

4 A NEW CONCEPT OF SCHEDULING. Once your order is given to Avnet, it knows no "weak-ends." Within a given period, Avnet ships more orders than any other source for electronic components, giving your specific order quicker delivery, faster use.

5 THE CONCEPT OF NEW CHALLENGE. Avnet doesn't know what the next decade will bring. But Avnet is very ready, willing and able to meet the challenge with *more* improvement in service, *more* newness, *more* changes for the better. For this is the very basis of The Avnet System.

AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP.

Avnet Service Centers and Stocking Facilities: Los Angeles, Cal. · Sunnyvale, Cal. · Seattle, Wash. · Salt Lake City, Utah · Chicago, Ill. · Dayton, Ohio · Westbury, L. I. · Burlington, Mass.

Avnet distributes from its stocking facilities: BENDIX SCINTILLA CONNECTORS, SPERRY SEMICONDUCTORS, RHEEM SEMICONDUCTORS, ELECTROSNAP AND HETHERINGTON SWITCHES, GREMAR CONNECTORS, CLARE RELAYS, ROBERTSON SPLICE & CONNECTOR CASES, BABCOCK RELAYS, KING SUBMINIATURE HI-TEMP CERAMIC CAPACITORS, TIC PRECISION TRIMMERS, VIBREX FASTENERS by GENERAL TIRE & RUBBER CO., U. S. SEMCOR SEMICONDUCTORS, SANGAMO CAPACITORS, SPRAGUE CAPACITORS

Circle No. 4 on Subscriber Service Card.

SLAG Makes Polaris Firings 'Fail-Safe'

Kearfott-developed system could be installed on surface vessels carrying operational birds; dual unit has perfect record

by Ben Strunk
Project Engineer
Kearfott Div., General Precision, Inc.

THE SAFETY OF shipboard personnel during surface test launchings of the *Polaris* IRBM is preserved by a unique fail-safe system called SLAG (Safe Launch Angle Gate) whose primary function is to prevent launching if the ship's list angle is unsafe.

Now installed aboard the Navy's USS Observation Island, it may eventually find broad operational use.

A revival of interest in this system has been sparked by the possibility that *Polaris* missiles will be installed operationally in surface vessels, as well as by the fact that the newer and longer-range *Polaris A-2* and *A-3* also will be test-fired from the Observation Island.

Developed by Kearfott Division of General Precision, Inc., for Lockheed, SLAG was conceived, built, and delivered to the Navy in less than six weeks.

Installed late in 1958, the system has been used continually ever since without failure.

TEST LAUNCH of dummy Polaris *from Observation Island shows how ballast and stabilizer fins impose list. SLAG would prevent launch when list is dangerous.*

• **Ignition failure serious**—When the *Polaris* is launched, compressed air is used to blow it into the air. Before the apex is reached, the first stage ignites. This is done to avoid blast effects and heat damage to the launching vessel.

But if the first stage fails to ignite, the missile could fall back onto the ship.

This problem is of course particularly severe when surface ships are involved. Although ballast and stabilizer fins are used to impose a list to starboard while the Observation Island is under way, normal ship roll could still present a problem.

SLAG was developed as the immediate solution to this problem.

The system is used in three ways:

1) to indicate visually (and accurately) angle of list,

2) to exhibit relative amplitude of roll, and

3) to prevent missile launching if the list angle is not safe.

• **Fail-safe feature assured**—SLAG is a self-contained dual unit. The Navy required that two complete systems be housed in one module, with "Permission-to-launch" switches arranged in series. Hence, if either system fails the other switch will remain closed and the missile cannot be launched.

Once it is determined which system was faulty, it is only necessary to flip a switch to place the good system in operation alone.

Each of the two systems contains the following equipment:

1) A vertical gyro.

2) A switching network which con-

COMPRESSED-AIR LAUNCH CHAMBERS installed in the USS Observation Island: in the foreground, a fixed vertical tube; in the background, a tiltable tube assembly.

tains on-off switches, indicator lights, time delay relays and circuit breakers.

3) A DC power supply.

4) A servomechanism-driven indicator assembly with switches for safety gating.

5) Remote indicators.

A clinometer is used to test the actual tilt angle of the vertical gyros. Results are compared with the system readout to check system accuracy.

Because of the duality of the unit, self-checking was not a design requirement.

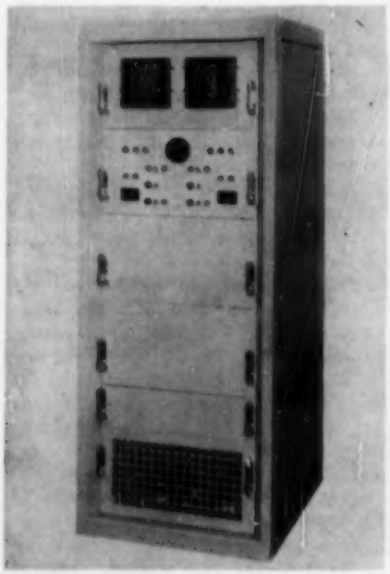
Three remote indicators are employed aboard the Observation Island: one near the SLAG console, one on the bridge, and one in the vessel's telemetering center. Indicators have a built-in memory to show maximum and minimum roll.

• **System operation**—The vertical gyro, which acts as a reference, transmits roll signals to the servomechanism assembly. In response to this signal, the servomechanism drives the indicators and switches, and a torque transmitter.

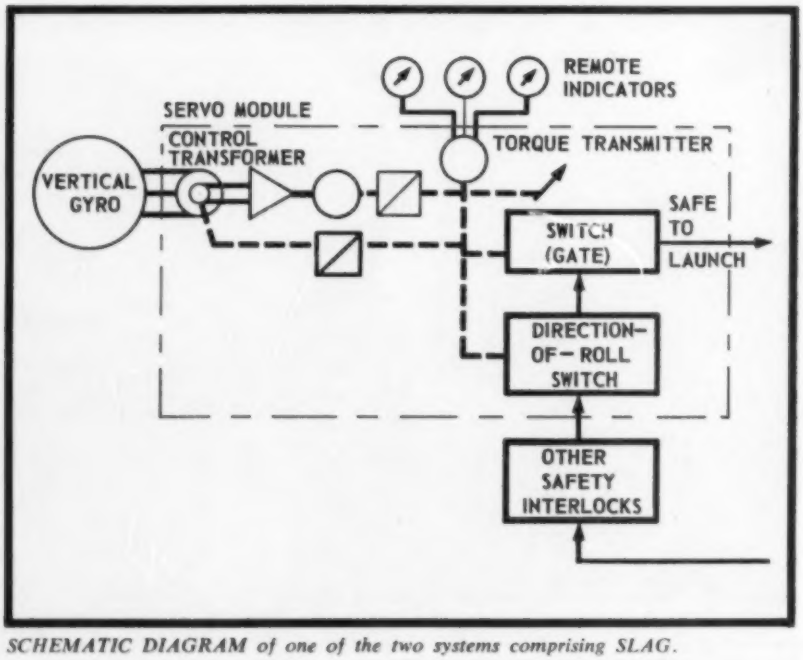
The torque transmitter in turn drives the three remote indicators to give a visual indication of the ship's list angle and the amplitude of its roll.

The servo closes a switch (gate) when a safe launch angle has been reached, and opens the gate when the ship is at, or rolling *toward*, an unsafe list angle.

The entire system indicates to an accuracy of ± 20 arc-minutes over a range of 15° port or starboard roll. The remote instruments indicate to an accuracy of ± 30 minutes. ⌗



SLAG actually is a dual unit containing two complete systems connected in series as a fail-safe feature.



SCHEMATIC DIAGRAM of one of the two systems comprising SLAG.

IBM's New Cryogenic Memory Planes

Automatic control techniques produce economically feasible volume of tiny components formed by thin-film deposits

CRYOGENIC THIN-FILM memory planes are now being fabricated successfully by International Business Machines Corp. as a production item.

For the first time, IBM scientists reported, fully automatic control techniques have been introduced to provide an economically feasible yield of the postage-stamp size components.

The memory planes employ 19 thin-film layers to produce a 135-cryotron assembly. Fabrication techniques were developed by IBM's Federal Systems Division laboratory in Kingston, N.Y.

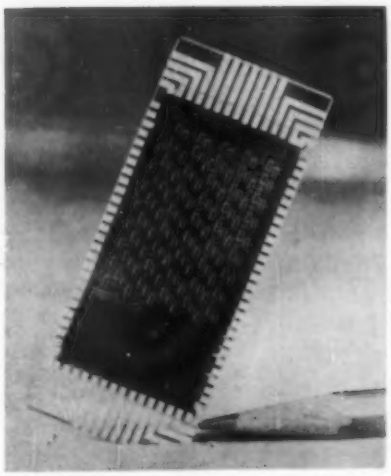
Cryogenics (using temperatures of the order of –450°F) have been employed for some time in devices used to perform logic and to store information in a computer memory.

In a cryogenic computer, cryotrons are used to perform addition, subtraction, multiplication, and division as well as logic, switching, and amplification.

In the new IBM memory plane, three cryotrons form a memory cell which combines storage with an elementary logic operation. Given this combination of functions, the company said, sophisticated operations not practical before may be realized. For example, IBM scientists expect that this concept may be used in an "associative memory," which simultaneously searches all memory compartments and thereby speeds access to any stored information.

• **Key to success**—The heart of this advance in cryogenic-device development is the technique permitting accurate duplication in the normal production of devices. In manufacturing the memory planes, microscopically thin layers of metals and insulating materials are automatically deposited on a glass substrate.

The equipment used for deposition allows each functional layer to be deposited sequentially through 17 microscopically adjusted masks, or perforated metal sheets. Masks are changed automatically and held in a large metal cylinder operating under high vacuum. Once the masks have been aligned properly, duplicate superconducting memory planes are produced automatically with similar electrical and mechanical characteristics.



STAMP-SIZE, 135-cryotron, thin-film memory plane made automatically by IBM.

Forty separate pieces or "bits" of information are stored in 120 cryotrons in the memory plane. Of the remaining 15 cryotrons, 10 permit access to the stored data; the other five are "in-line" cryotrons which switch information bits from one memory plane to another.

These newer "in-line" cryotrons, reportedly, operate faster than conventional cryotrons in communicating between the memory planes. They also permit faster communication between the memory planes and the arithmetic portion of the computer.

Basic building block of the cryogenic memory plane consists of three crossed-film cryotrons in combination with a persistent current loop to make up a storage cell. The word-oriented (two-dimensional) memory plane consists of eight-word registers with five bits/word, providing a total of 40 memory cells.

Research is being continued to refine the thin-film fabrication techniques for producing cryogenic devices at even greater speeds, the company said. ⌗

AUTOMATIC deposition equipment developed by IBM's Federal Systems Division for sequentially depositing 17 crossed-film layers on a glass substrate.

From RCA The Most Trusted Name In Electronics

RCA 110 Electroni

Engineered to withstand the rigors of industrial environment...an ultra high-speed control system ...tailored to your exact needs

The RCA 110, an advanced solid state industrial computer, offers capabilities that range from simple automatic monitoring and recording to complete real-time computer control of complex industrial operations.

From its very concept, the RCA 110 was designed for continuously operating processes, and built for maximum effectiveness under the hardest industrial usage. It is housed in dust-tight heavy steel cabinets and air-cooled by internal heat exchangers to guard against contamination from outside atmosphere. The entire system is programmed so that it will continuously check itself. In the event of main power failure, the RCA 110 calls into action a "safe shutdown" sequence without loss of computer memory or instability to the controlled system. Wired priority interrupt helps make the RCA 110 the m efficient industrial computer offered anywhere.

Like all RCA Electronic Data Processing Syste the "building-block" concept of the RCA 110 p mits custom-assembly of the system according your special requirements, and easy expansion your needs demand.

For detailed information on the world's most vanced industrial control computer, ask your ne est representative of the Foxboro Company, or wr —Industrial Computer Systems Dept., Electro Data Processing Division, RADIO CORPORATION AMERICA, 21 Strathmore Road, Natick, Mass.

The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

6 REASONS WHY THE RCA 110 IS THE WORLD'S MOSFIC

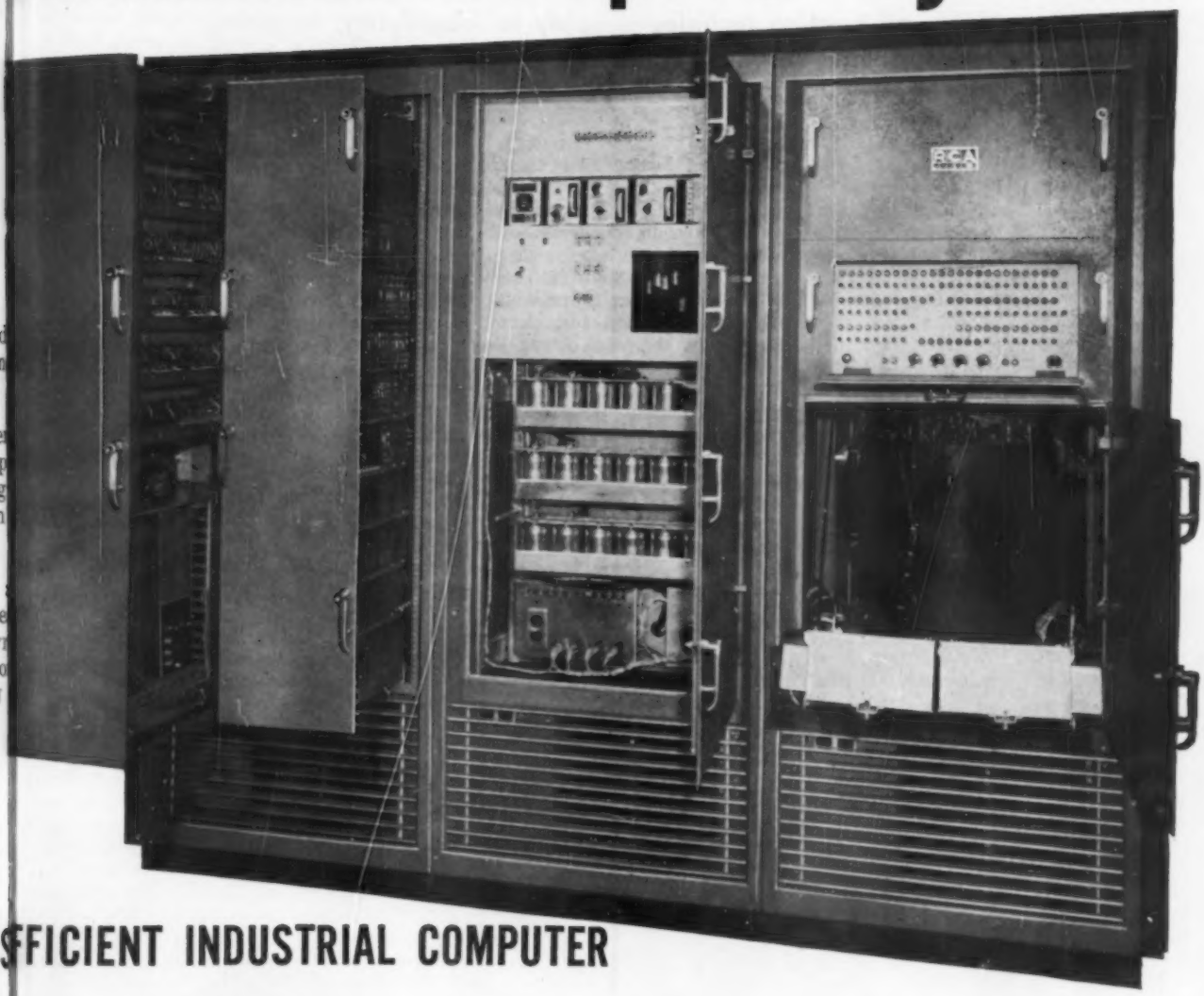
DESIGNED FOR FAIL-SAFE CONTINUOUS OPERATION even under the most exacting factory conditions. Dust-tight, heavy-duty all-steel enclosures are equipped with industrial heat exchangers for internal cooling to prevent contamination from outside atmosphere. Requires no false flooring or other special site preparations.

UNIQUE PRIORITY INTERRUPT FEATURE enables computer to automatically select the most urgent task from multiple demands. Operates on programmed priority basis, to avoid traffic jams and to handle emergency situations immediately. Result—programs are easier to write, memory space is conserved, and computer free time is automatically assigned to self-checking routines.

MAXIMUM SYSTEM ACCURACY IS SAFEGUARDED with SY MAIN impedance, single path ground scheme—permits low l essible signals to be processed by computer, eliminating cross assis. In interference from main frame currents. Employs solid s manu per, 150 pound bus bar as integral part of grounding syst ues to o designe

HEAVY DUTY SOLID STATE POWER SUPPLY includes separ margina metering and adjustment of all DC voltages, automa per ope alarming of over-voltage, and circuit breaker protect against current overload. Motor driven control elimina start-up shock and prolongs life of all components. Rese DULAR capacities in power supply, plus priority interrupt rout m and c safeguard memory information, and safely shut down w hour computer in event of main power failure. Entire syst the num sectioned and metered for high-speed, automatic check- increas

industrial Computer System



FFICIENT INDUSTRIAL COMPUTER

SY MAINTENANCE EVEN DURING OPERATION—all circuits essible from front in extendable drawers and hinged assis. Industry's most complete maintenance panel per- s manual check-out of complete system. Computer con- ues to operate with all drawers fully extended. Circuits designed to perform at high temperatures—have built- marginal testing, and an automatic alarm signals im- per operating voltages.

DULAR DESIGN PERMITS FIELD EXPANDABILITY — both m and core memories can be expanded in the field within w hours as additional tasks are assigned to the computer he number of inputs, outputs, and data manipulations increased.

COMPARE THESE PERFORMANCE SPECS

Speed — including access time and staticizing, adds in 56 microseconds, multiplies in 728, divides in 868. *Instructions*—one address (limited two address), 7 indexable address registers, 71 wired-in instructions. *Number System*—fixed point, binary or binary coded decimal. 24 bit word length, word time 28.89 microseconds. *Working Storage*—magnetic core, coincident current, variable in size from 256 to 4096 words, 8 high-speed input-output registers, clock frequency 936 kilocycles. *Bulk Storage* — magnetic drum, 3600 rpm, 4096 to 51,200 words, 8.3 milliseconds average access time, 200 kilocycle transfer rate, up to 12 buffer tracks for input-output. *Size*—82" high, 34" deep, 105" long. *Typical Power Input*—5 kva, 220 volts.

Seismology Takes To Undersea Warfare

Dresser finds oil hunting techniques apply to identifying, targeting enemy submarines; beacon built for ocean bottom Polaris navigation

by Hal Gettings

HOUSTON—Detection of enemy submarines—one of the knottiest problems plaguing our undersea defenses—is being improved by techniques developed for locating underground oil deposits.

Although any rational connection between the two might appear farfetched, there is actually much in common between seismic oil exploration and certain aspects of antisubmarine warfare. Many of the problems are the same, or similar. And the solution to these problems in one area often applies directly to the other. In short, if you can find oil, you can find submarines.

In searching for oil, explosives are detonated under the earth's surface and recordings made of the energy waves reflected by the explosion. Analysis of these recordings provides the seismic engineer with data as to location and composition of particular characteristics of the earth's substrata. From this, geophysicists deduce the chances of finding oil in certain locations.

Some of the same principles apply to the detection of submarines beneath the surface of the sea.

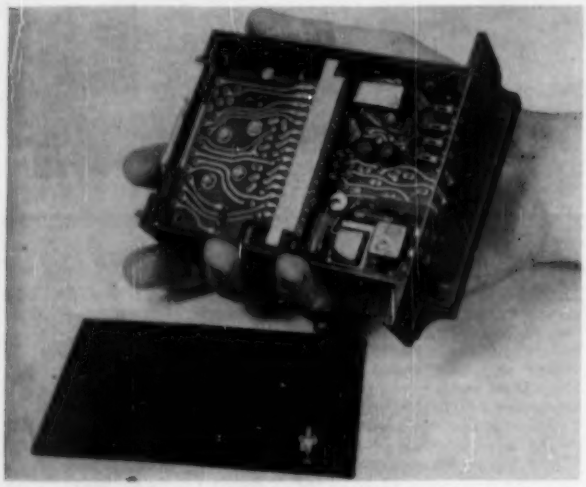
A good example of the application of these techniques to the development of systems to find and identify submarines is the work being done by Dresser Electronics' SIE Division. Drawing on an extensive 15-year background in seismic exploration, SIE has turned a large part of its effort toward producing ASW equipment. They began their "plowshares-into-swords" approach several years ago and have since become deeply involved in sonar research and development. Similarly, their oil experience has been profitably applied to instrumentation for missile telemetry and space applications.

• **Underwater beacon for Polaris subs**—As one example, know-how developed from both seismic experience and well-logging instrumentation—with its extreme environmental temperature and pressure requirements—was used in the recent development of an underwater navigational beacon.

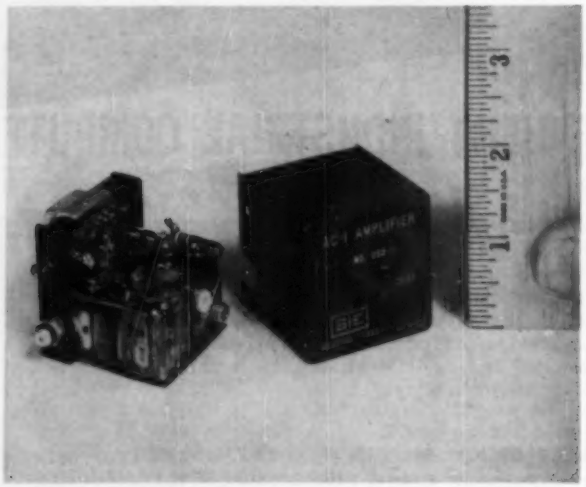
This beacon, part of the *Polaris* program, required sound levels and efficiencies in a package size and weight thought to be absolutely incompatible. The Dresser approach was selected by the contracting agency as "very interesting, if possible." The end result was a navigational beacon to specifications including operation at ocean bottoms down to 20,000 feet.

• **ASW surveillance system**—Dresser is developing an underwater target identification and display system for the Navy. Details are classified, but the design is based on seismic data processing and digital computer techniques. The system is directly adaptable to solution of ASW surveillance display and target recognition problems.

The display system is preceded by a digital multibeam formation system so that surveillance is effective in all directions at the same time. The mass of data collected is computer-processed, since no sonar operator could assimilate the data and make a deci-



TRANSISTORIZED signal-conditioning module built by Dresser has telemetry applications for Subroc, Polaris missiles.



COMPLETE MULTISTAGE a-c accelerometer amplifier is packaged in 1½-in. cube. Device grew from geophysical work.

sion in the required time nor separate targets of interest from false targets.

Processed data is displayed to the operator at high signal-to-noise ratio and with a given "level of confidence" cranked into the system to suit the surveillance requirements of the situation. Thus the operator can exercise his recognition and decision function with clear and uncluttered data.

Another family of devices, perfected for portable oil exploration use, is Dresser Electronics' solid-state miniaturized power supplies. These already-ruggedized units required only a minimum of redesign for immediate application in aircraft, missiles, and submarines. Used in *Polaris, Pershing* and other similar projects, such power supplies are now being considered by major airlines for civilian use.

• **Back to plowshares**—The experience cycle is now turning full circle. Dresser finds that know-how gained on military contracts leads directly back into new developments for the industrial market.

From combined military and seismic engineering groups has emerged a new solid-state geophysical amplifier that combines transistors with other compatible solid-state components to take advantage of entirely new circuits that yield significant improvements in amplifier performance.

• **Building national radiation monitoring system**—Product capabilities have now been extended into complete systems concepts. A current example is an automatic radiation monitoring system being developed for the Office of Civil and Defense Mobilization (Project ARMS).

ARMS—a "system within a system"—in nationwide use will allow civilian defense personnel to answer two vital questions following atomic attack: is any given populated area safe or unsafe? If it is unsafe, where can the people be sent?

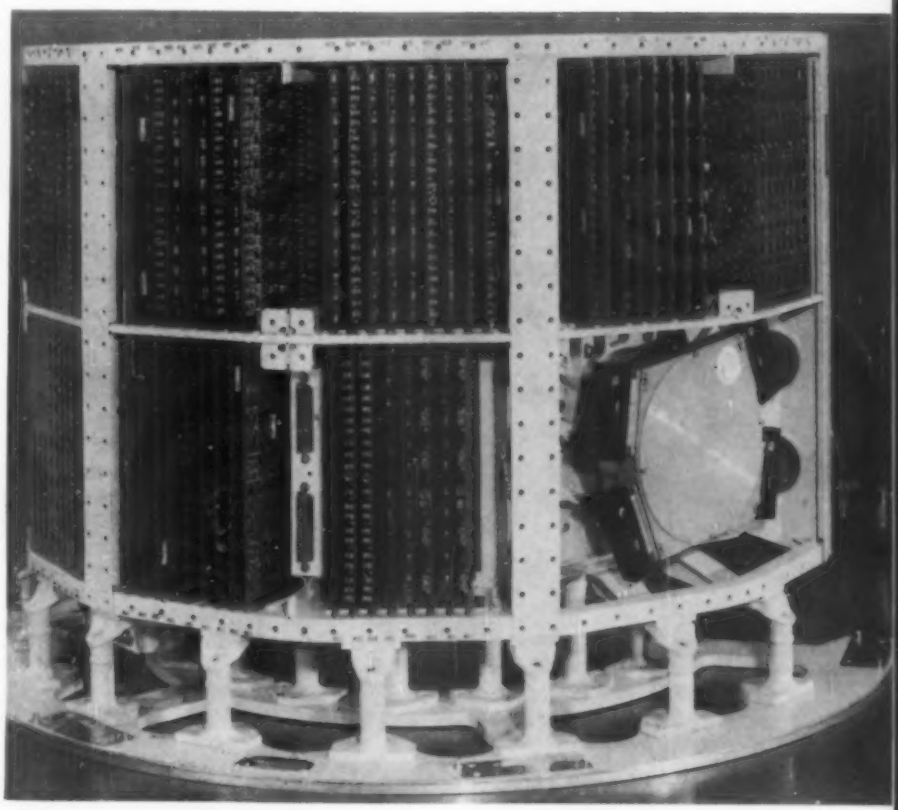
To inform supervisory defense personnel of relative radiation intensity in a populated area, radiation monitors are located within the area at strategic points. These are connected either by wire or low-powered radio to a central interrogation and monitoring unit. At this central point, the existing radiation level is displayed automatically on a continuously up-to-date map of the area.

A network of similar radiation monitors will also be established on a nationwide scale, with approximately 64 monitors in each "block" of a grid pattern. Reports from these monitors will be fed to data reduction centers and the data displayed on a chart similar to that used for the city units. Field testing of the prototype ARMS units is scheduled to begin soon. ⌗

First Photos . . .

Autonetics Unveils Minuteman Computer

IN ITS MAIDEN flight test from a silo at Cape Canaveral, a full-scale *Minuteman* will carry aloft in its all-inertial guidance package the cylindrical digital computer shown here. These first photos show it being vibration tested (at right) on a shaker at Autonetics, North American Aviation, which developed the *Minuteman* guidance system. The unusual shape of the solid state computer (below) permits it to fit compactly in the guidance compartment. The computer, in addition to in-flight functions, also performs ground checkout duties prior to missile firing. First test of *Minuteman*—with all three stages firing and with operational prototype guidance—is now expected late this month or early in February. GSE problems have delayed the shot a month.



High Temperatures Foiled By Foam

"Self Sacrificing" polyurethane coating applied by spraying Two-part Material Bonds tenaciously to most surfaces

DEVELOPMENT OF D-100 foam has given Dynatherm Chemical Corp. a double-barreled approach to the high-temperature coating problem. The foam, developed just a few months after D-65, an intumescing coating, has properties somewhat different than the previously marketed product. (M/R, March 28, p. 27)

A two-part mix, D-100 has been extensively tested under flame temperatures of 6000°F, losing 20% weight and 8% volume over a one-minute period. Tests were conducted on a 1-in. sample, with the flame 6 in. away.

Elbert Davis, Dynatherm's president, described the material as a self-sacrificing foam which does not melt or fracture under high heat conditions. He said production of the foam ingredients can be made in any quantity, and they are now available for commercial use.

Features of the polyurethane coating include rapid application and curing time, rigidity and ability to be deposited in very thick heat-resistant layers. D-100 also has insulating qualities that its predecessor does not have.

In recent tests Davis said, a nose cone configuration utilizing both D-65 and D-100 was subjected to a plasma jet with favorable results. The cone consisted of 60 mils of D-65 on the outside surface of 1/8 in. of graphite, backed up by 1/16 in. of D-100. The D-65 withstood 10,500°F for 10 seconds with less than 200°F temperature rise occurring on the inside surface of the cone by the end of the test.

The nearest competitive system under the same conditions allowed a 1000°F temperature rise inside the cone within three seconds. The particular instrumentation scheduled for use in the operational configuration of the cone could not tolerate the fumes generated by the D-100, however, and it was removed from the system. This is not a universally-applicable disadvantage, Davis said.

Slightly less expensive than D-65, the D-100 coating will be applied by a special metering and spraying machine developed for use with the material. The nature of the chemical action in D-100 requires that it be applied to the surface within a few seconds after mixing. This prevents mixing of large batches before application, and the special machinery will meter, mix and spray the coating automatically and with proper timing.

Now under evaluation for military service, D-100 has already been written into some specifications for heat-resistant equipment. The material bonds very well to most surfaces. A critical relay in *Minuteman* is currently using a shell of D-100 for heat protection as an evaluation test for production use.

• **Visual control**—Coloring of the ingredients provides a quality control device. With one ingredient black and the other white, a final shade of gray is attained which indicates if the proper mix ratio has been achieved. Any off-color shades are easily spotted as deficiencies in the mix ratio or in the foam's homogeneity. Total curing time for D-100 is about 30 minutes.

In its continuing program on high-temperature coatings, Dynatherm expects to include powdered ceramics and metals such as boron or titanium in the coatings, in order to bridge the gap between organic materials and inorganic coatings. The company also hopes to make a flexible version of the D-100 coating, along with versions featuring higher and lower densities than the 13 lbs./cu.ft. now offered. Other programs now in the works include better self-sacrificing materials which will erode at a controllable rate.

"I think this is a trend in such areas," Davis said, "because we are now reaching the limits of high-temperature materials as we've known them, and slower and slower progress is being made. We're taking another approach to the problem and we think it will pay off, where the application involved can afford the little space needed for a foam material." ¤

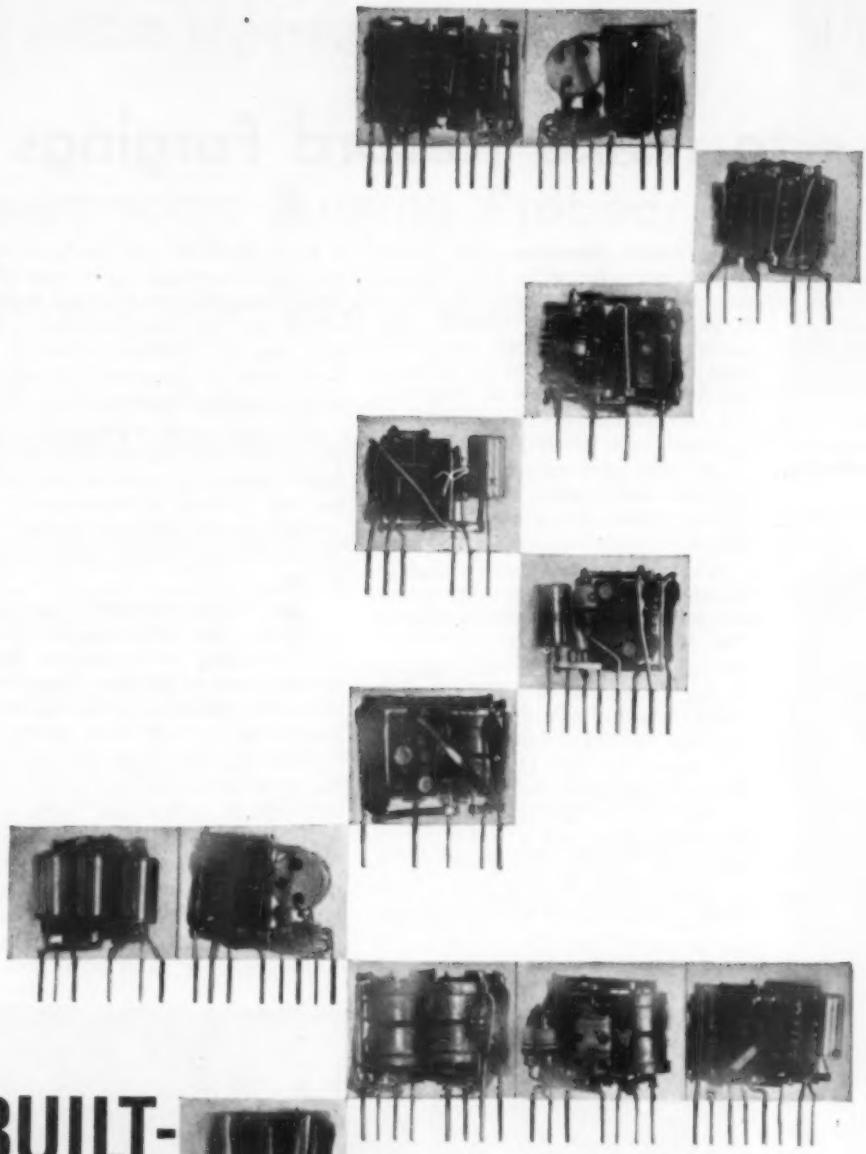
OXY-ACETYLENE FLAME reaching temperatures of 6000°F is applied to foam in lab test of properties. The 1-minute run resulted in 20% weight and 8% volume losses.

Man-made Diamonds Cross One Carat Mark at G. E.

LARGE DIAMONDS, in excess of a carat, are being made by researchers at General Electric Laboratories, Schenectady, N.Y. The gems are dark in color and are not yet of sufficient mechanical strength for industrial applications.

The large diamond work is still in the early development stage. Dr. Guy Suits, director of research, says it is impossible to predict when the stones will reach commercial applicability.

The Laboratory has already succeeded in manufacturing 0.1 carat diamonds with excellent industrial qualities but these are not yet available on a commercial scale. The first man-made diamonds produced by GE in 1955 were only thousandths of a carat in size.



BUILT-TO-ORDER COMPUTERS

...with off-the-shelf components

Delco Radio can design, develop and deliver digital computers with the speed you need, for airborne guidance and control as well as a wide variety of other special applications. ■ With off-the-shelf Delco transistorized digital circuits, we have, for example, built a computer for a military application in less than three months. ■ These miniature modules contain standard components. They satisfy all MIL-E-5272D (ASG) requirements, which assures extremely rugged, reliable computers. Continuing life tests on these computer circuits now exceed four and one-half million transistor hours *without a failure*. And where space is no problem, you can have these same, reliable digital circuits packaged on plug-in circuit cards. ■ Delco Radio has six sections of highly experienced people with the necessary capabilities to produce complete computer systems: Application Analysis, Systems, Logic, Memory, Circuit Design and Advanced Development. May we review your requirements? Just contact our Sales Department. ■ *Physicists and Electronics Engineers: Join Delco Radio's search for new and better products through Solid State Physics.*

PIONEERING ELECTRONIC PRODUCTS THROUGH SOLID STATE PHYSICS

DELCO RADIO
DEPENDABILITY
RELIABILITY

Division of General Motors • Kokomo, Indiana

Circle No. 6 on Subscriber Service Card.

Huge Press to Make Record Forgings

THE WORLD'S LARGEST multiple-ram forging press designed specifically for working steel, refractory metals and high-density alloys, went into operation recently at Cameron Iron Works, Houston, Tex.

The 20,000-ton closed-die press was designed by Cameron engineers and built in six months with the cooperation of Brown and Root, Inc., Bethlehem Steel Co. and Wyatt Industries, Inc.

With 15 feet of daylight, the press will turn out larger and more complex forgings than ever before possible. In addition, Cameron engineers expect a higher degree of controlled and uniform physical properties.

The frame is 50 ft. from bottom to top and 31 ft. in width. The bottom platen is 12 ft. square and the total stroke is 90 in. When the side rams have been installed they will exert 5000 tons each—with intensification, 7500 tons each. The piercing ram inside the main ram has a down acting range of 4200 tons. The four pull-back rams have a gross of 940 tons. The net stripping force is 400 tons with the bottom knock-out punch rated at 650 tons.

• **Vertical Extrusions**—The operator can drop the main piercing ram assembly out of the press, leaving a 56 in. hole in the main bolsters, in the moving platen, and in the top platen. Thus extrusions up to 30 ft. in length and 56 in. diameter can be produced. The only limitation is in the 30,000-lb. maximum billet weight.

No other press can approximate this extrusion ability and Cameron is eyeing the missile case area with renewed interest.

The throttling, or flow, control on the press is such that the machine can be operated anywhere within a range of 0 to 400 feet per minute.

Cameron perfected the split-die forging technique which drastically works the metal into shape in one heat and with a single, multiple forming, operation. On their 11,000-ton press, the main ram closes the die on the billet, two side rams pierce or forge in the horizontal plane and a vertical piercing needle is used to fill the die cavities.

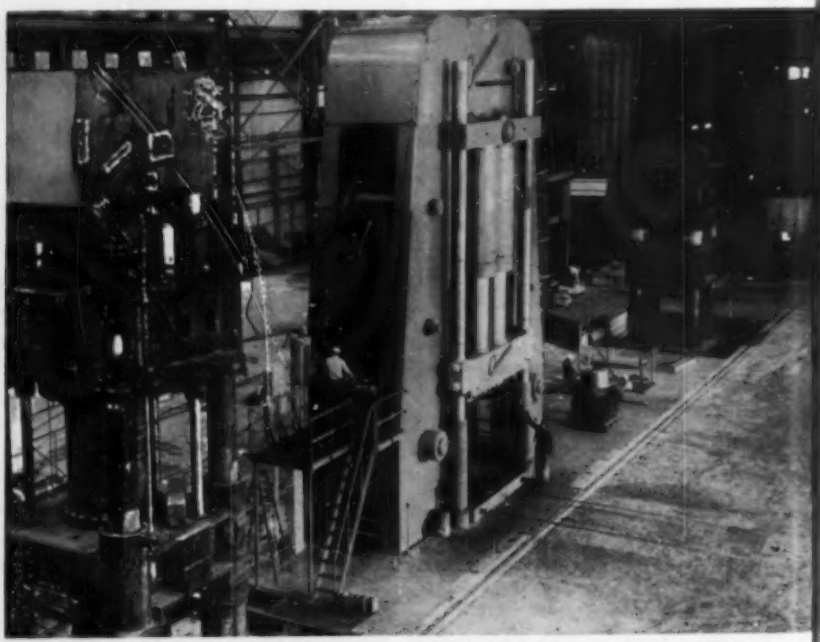
This internal working of the metal breaks up segregated material inherent in the billet center and results in forgings that consistently meet high ultrasonic standards. The closed method avoids the flash line magnetic indications and the localizing effect of the flash grain on transverse, fatigue and stress rupture properties.

The new press extends this technique to larger pieces. It is the fifth largest closed-die press in the world, the other four are Air Force-owned and shared equally between Alcoa and Wyman-Gordon (M/R, Feb. 1, 1960, p. 18)

The 20,000-ton press weighs in at 3,158,000 lbs. excluding foundation. This is slightly more than the weight of the firm's 11,000 ton press, which gives some indication of the engineering innovations included in its design.

Cameron engineers will be using the press for nuclear reactor, jet engine and missile component applications. Molybdenum, tungsten, tantalum, moly tungsten, tantalum tungsten, columbium, and the more exotic alloys can be handled, especially as extrusions. ⌗

OPENING DIES REVEAL a 6000 lb. hollow aircraft shaft of A286 stainless steel.



CAMERON'S 20,000 TON PRESS stands amid auxiliary presses. The accumulator system in the background consist of four Babcock & Wilcox units.

Supersonic Burning Probed; May Bring New Type Missile

NBS laboratory observes new phenomena—laminar combustion

NOVEL TYPES of propulsion units may evolve from supersonic combustion studies now under way at the National Bureau of Standards.

The Bureau is exploring techniques which would generate thrust by having the burning process take place at supersonic speeds either inside—or on the exterior of a missile.

The Bureau also claims that the new study technique will help in the design of flame holders for supersonic combustion.

The method calls for firing a missile at hypersonic speeds through a combustible gas. Then high-speed schlieren photography is used to get data about the shape and detachment distance of the shock wave, gas density and other effects.

This information is evaluated to get a picture of the combustion process in the vicinity of the missile.

The experimental method was devised by F. W. Ruegg of NBS' combustion controls group. It is said to be a very low-cost method which has the added advantage of allowing experimenters to control precisely variations such as pressure, temperature, fuel and missile speed. This can be done over a wide range of values and under realistic conditions.

• **A new phenomenon**—During the studies, laminar combustion in a supersonic stream was observed for what experimenters believed to be the first time.

NBS also reported observing an unusual occurrence—large-amplitude oscillations in the megacycle frequency range produced by the combustion process at the front of the missile.

Under the Ruegg technique, a shock wave is established ahead of a high-speed missile. Then the conditions needed to induce combustion are found, and the effects of the missile on the combustion process determined.

The stagnation temperatures attained by this procedure are said to be realistic. The results are not affected by the method of mixing air and fuel or by turbulence.

The experiment can easily be modified to determine the effects of the temperature and pressure of the combustible gas on the combustion in the shock wave.

The Bureau's experiments were performed at Mach numbers from 4.2 to 6.5 in a mixture of hydrogen (30% by volume) in air. Combustion was initiated by means of compression and heating within the shock wave on the missile.

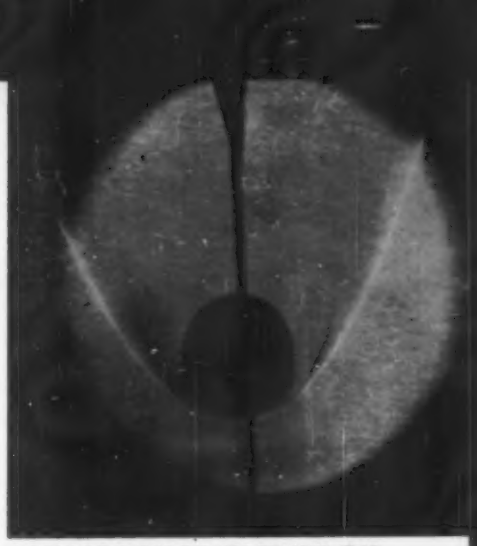
It was found that characteristics of the combustion process depended strongly on the Mach number and on the state of the gas ahead of the wave.

• **Apparatus used**—The experimental apparatus comprised three essential parts. First, a gun and a range that contained the missile and the test gas. Second, an electronic time-delay-ratio generator that computed the time to fire a high-voltage flash lamp. And third, an optical system for schlieren photography.

In the experiments, 0.785-in.-diameter nylon spheres were used as the missiles. They were mounted in a 20-mm case containing a fast-burning gun powder. They were fired from a .60-caliber, 6-ft-long test barrel through a blast chamber and test section into a heavy metal target and trap.

• **Results**—When the missile was traveling at a speed near Mach 4, separate shock and laminar combustion waves were observed at the front of the sphere. At about Mach 5, combustion was intermittent.

At higher speeds, the wave shown at the front of the missile was considered to be a strong detonation wave which separated into a shock and a laminar combustion wave.



SCHLIEREN PHOTOGRAPH CAPTURES what is believed to be first observation of laminar combustion in a supersonic stream. Missile M = 5.53, P(Abs.) = ¼-atmos.

ANOTHER SCHLIEREN PHOTOGRAPH shows large-scale oscillations in the megacycle frequency range. These were generated by the combustion process at the front of the missile. Missile M = 4.90, P(Abs.) = ¼-atmos.

At pressures of ¼ and ½ atmosphere, combustion caused the stagnation temperature to rise in the detonation wave by an estimated 700° and 1000° C., respectively—above the temperature due to the missile's motion.

The frequency of the intermittent combustion at the front of the spherical missile was estimated at 0.8 megacycles. Although extremely high, this frequency is not unreasonable when one considers the ignition delay time observed in experiments where combustion is steady.

This NBS study technique is being supported by the Navy Bureau of Weapons and the Air Force Office of Scientific Research.

Status problem . . .

Engineers Have 'Inferior' Feeling

Survey finds engineering talent in industry worries about pay, professionalism in relation to higher-living doctors and lawyers

by William Beller

ONLY ONE OUT OF SIX engineers is satisfied with his profession. In fact, at least one out of every seven engineers thinks that engineering for industry is not even a profession.

These are the findings of a survey on engineering professionalism in industry made for the Professional Engineers Conference Board for Industry in cooperation with the National Society of Professional Engineers.

The survey is based on 350 interviews held between April and August last year and made by Opinion Research Corp. of Princeton, N.J.

What stands out in the findings is the engineer's intense desire to do creative and challenging work. The majority interviewed put this as their chief interest and reward, even above salary considerations—and far above questions of job security and status.

Still, for 36% of the engineers, salary was the most important item.

In the overall view, more than half the engineers said that higher pay would certainly advance engineering as a profession. It was not unexpected that less than one-fifth of the industrial managers agreed.

• **Who was in the survey**—All the engineers interviewed were working in recognized engineering assignments—no subprofessionals or technicians—and held college or advanced degrees in engineering. They were all with large companies employing many engineers.

The industrial managers interviewed included directors of industrial relations, vice presidents for production or production managers, chief engineers or managing engineers, project engineers, coordinators and the like. The interviewers' objective was to talk with men who set policies for the engineers in the companies represented.

The companies involved were representative of six major industries: chemical, electrical instruments and manufacturing, electronics, missile manufacturing, petroleum and rubber.

Even though the chief products of these companies came from engineering, the engineers themselves seemed to be suffering from feelings of inferiority. Only three percent of them felt that they had a higher status in their companies than the doctors and lawyers employed there.

Among the reasons given were that doctors and lawyers made so much more money than the engineers that they necessarily must command greater respect. They also have more of such symbols of office as private secretaries, parking spaces and longer lunch hours.

Furthermore, the doctor and lawyer were said to be their own bosses. "Their activities are unsupervised, they are free to come and go as they want. On the other hand, the engineers must sign in and out."

Implicit in the survey statistics was that the word "doctor" was considered synonymous with "physician" and not with "Ph.D."

• **No agreement on professionalism**—Only the industrial managers were anywhere near agreement on the criteria for "engineering professionalism." They said it called for technical competence and skill, and high standards of learning and ability.

On the other side of the coin, only a quarter of the engineers saw a relationship between these standards and professionalism. Their criteria for professionalism ranged from having "something like" the American Medical Association or Bar Association, to generating ideas, being effectively used, having a high standard of ethics, and being registered.

Most of the engineers and managers felt that building professionalism was very important for the engineers' and company's welfare. They also agreed that it was management's responsibility to advance engineering professionalism at the company.

Here are some of the things they said management could do.

–See that salary progression fully reflects engineers' contributions.

–Encourage engineers to find out how their work fits into the entire project.

–Give engineers as varied and challenging work as possible.

–Give engineers adequate supporting personnel.

–Keep engineers informed on company objectives and policies.

Most of the engineers said that there were things they could do for themselves to build up their professionalism—and that they were doing them. Here there was sharp disagreement from the managers, who claimed that the engineers were doing very little to advance their cause.

This poor opinion on the part of the managers was of high concern to the interviewers. They said that either (1) the engineers have to re-evaluate much of what they do now, or (2) they need to communicate better with their managers regarding the things they are doing to build professionalism.

Here is what the engineers say they are doing:

–Learning business objectives of their projects.

–Belonging to professional societies.

–Developing communication skills.

–Keeping informed on business conditions affecting the company.

–Keeping informed about the functions of the company.

–Seeking further education.

• **No love for trade unions**—Industrial managers were almost 100% agreed that unions hurt engineering professionalism. The engineers were not so adamant, although most of them (64%) agreed with their managers.

Among the reasons given were that the professional man should be treated as an individual. He doesn't want to lose his identity and become "part of the mob," which he would have to be as part of a bargaining union.

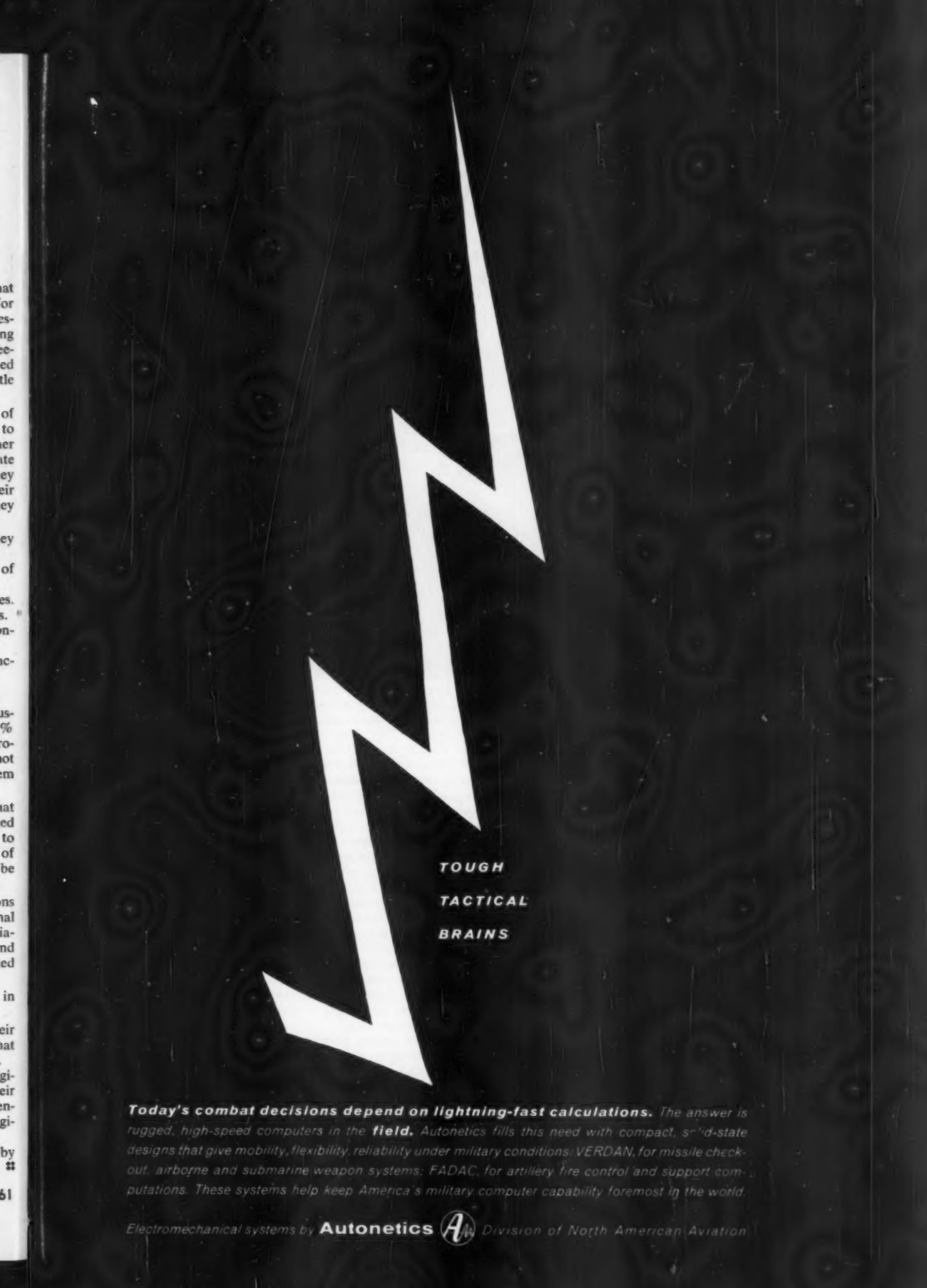
In addition, it is asserted that unions are associated with nonprofessional groups; they lower standards of initiative, accomplishment and ability; and in some instances have been associated with corrupt influences.

The survey can be wrapped up in three conclusions:

First, engineers can advance their cause best by doing those things that make them better qualified engineers.

Second, managers can advance engineering professionalism by giving their engineers the best possible working environment and recognizing their engineers' achievements.

Third, both groups can do much by improving their intercommunication. ¤



Today's combat decisions depend on lightning-fast calculations. *The answer is rugged, high-speed computers in the* ***field.*** *Autonetics fills this need with compact, solid-state designs that give mobility, flexibility, reliability under military conditions: VERDAN, for missile check-out, airborne and submarine weapon systems; FADAC, for artillery fire control and support computations. These systems help keep America's military computer capability foremost in the world.*

Electromechanical systems by **Autonetics** *A Division of North American Aviation*

Swedes Develop Versatile Air Rockets

close support of ground troops as well as fighting aircraft are requirements of Bofors, SAAB systems

by Bernard Poirier

TWO SWEDISH FIRMS have developed a number of versatile air-launched missile systems using both highly specialized air-to-air weapons and domestic rockets designed to destroy both land and air targets.

Responsible for the systems are AB Bofors and Svenska Aeroplan AB (SAAB). The platform, electronics and computers are supplied by SAAB; Bofors provides the last stages—rockets and warheads.

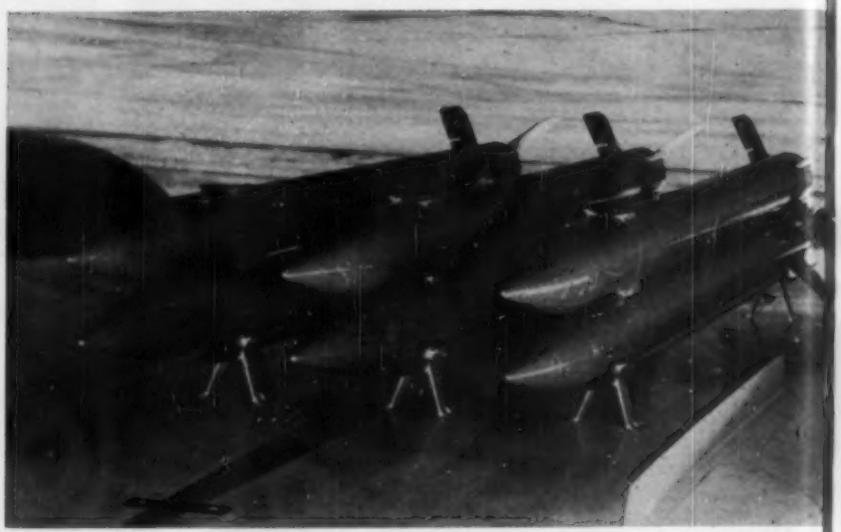
For the high-performing "Lansen" and "Draken" fighter/attack aircraft, SAAB perfected an All Weather Gun Sight (infrared and optical), a Fire Control system with Ballistic Computers for collision course tactics or lead pursuit attacks.

Essential to the aircraft's attack potential is reliability of optics, infrared detection and radar readings and read-out. Bofors, meanwhile, developed three rockets whose propulsive reliability and aerodynamic capabilities would react quickly and surely on the heels of command impulses from aircraft-contained guidance computations.

Bofors rockets—the *M 55* (7.5 c.m.), the *M 56* (13.5 cm.) and the *M 57* (7.5 cm.)—are essentially the "stingers" of a system whose entire guidance structure is contained for future use within the carrier-aircraft. The firing dispersion is small, accenting accuracy. In tests at 1200 yds., dispersion has been less than 4 yds.

For daytime, clear weather air interceptions, the SAAB system utilizes optically orientated information correlated to artificial aiming mark and artificial horizon plus range data. For interceptions at night or in clouds, target information is relayed via external angular-tracking radar or from infrared detectors. A complete airborne electronic package weighs 130 lbs. and requires 1.5 cu. ft. There are 74 miniature and sub-miniature tubes with 107 tube functions.

Information from the optical sighting head is generated electronically on the screen of a projector-type cathode ray tube. Information gathered from radar or infrared readings follows the same course through an amplifier whose program merges the findings with aiming mark and horizon.



THESE ROCKETS designed and built by AB Bofors are an attack armament version of 13.5 cm air-to-ground rockets of a new type. Twelve rockets, six under each wing, can be carried by the SAAB-35 "Draken."

Svenska Aeroplan engineers describe their Ballistic Computer as one whose settings are established prior to take-off in an outside switch panel to adjust for the aircraft's particular armament. They say, "The Ballistic Computer receives range, air data and attitude signals, and generates for the armament selected the currents necessary. It contains several function generating servos, each consisting of flat, nonlinear potentiometer cards and a common servo-driven wiper arm."

• **Disadvantage to Collision Tactics** —Lead pursuit interception is similar to former dogfight tactics except for the electronics necessary with today's high speed aircraft. Features of head-on or collision course tactics are "less strain on the pilot" resulting in more accurate human reactions, the "time gain" as the fighter comes in and the "disadvantages" presented to the enemy who can not loosen defensive weapons efficiently due to high angular velocity of sight, high closing velocity and the ballistics of crosswind shooting.

The Fire Control system already contains the rocket characteristics fed into it prior to take-off. Function signals from the radar, air data system and central gyro platform are received into the electronics system to determine the firing sequence of the rockets.

Collision source tactics are described as deadly but some limitations are evident. The enemy aircraft is easily placed into a pattern where he can be destroyed as easily as a pheasant in the open. A complete rocket salvo is needed in this operation, leaving a pilot with little choice other than to make his presence limited to the vicinity of battle, just in case. The company itself points this out.

SAAB's ballistic computer is the analog type, working with 400 cps AC signal voltage.

The Bofors *M 55* was designed primarily for combatting medium or heavy bombers. It has high velocity,

little dispersion, low weight and a large bursting charge. Velocity at 32,000 ft. altitude is 2624 ft/sec.

The fuze is the highly sensitive instantaneous direct-action type with shutter, delayed safe arming and self-destruction devices. The bursting charge is described as "0.75 kg. Hexotonal (TNT/RDX/A1)." The propellent burns for 0.9 sec. Its double-base powder is temperature-compensated; at —60°C the burning time is increased by 10%, at +50° C it is reduced by 20%.

There is insulation between the motor tube and combustion chamber so the casing exterior maintains original temperature during burning time. The fins are slotted to form the rear suspension points for the rocket underneath in a rocket stack. The nozzle has a sealing washer.

Moveable shear pins hold the rockets in position. Thirty-two rockets can be fired in .3 sec. in salvos of 8, or in .42 sec. in salvos of 4. When the firing button is pressed an automatic transmitter discharges firing impulses.

The *M 56* was designed for use against surface targets. It has a 5 5/16 in. diameter, weighs 90.4 lbs. and is almost 6 ft. long. Velocity is 2130 ft/sec. The 50% radial dispersion (R50) is about 4 mils when firing in series. The warhead weighs 39.7 lbs. and the TNT charge accounts for 20% of the weight. It will pierce 1 3/16 in. iron plate or about 1 in. armor plate at a 60° impact angle. The double base propellent burns for 2 secs.

Bofors modified the *M 55* to develop a pod-firing rocket with a new electrical system and a retaining spring design. In this case, the retaining spring is sheared off at firing. The pod-firing rocket is the *M 57*. It has seven folding fins replacing four fixed fins. The new *M 57* can be fired more quickly—at intervals of 10-20 millisec., depending upon the value for which the interval transmitter in the pot has been set. ⌗

First European Space Technology Symposium Set

The British Interplanetary Society will hold the first European Symposium on Space Technology in London this June.

Its purpose is mainly to bring together engineers and scientists from Western Europe to discuss the possibility of formulating a joint program of space research. It will be open to participation by countries in Western Europe, particularly those belonging to the Organization for European Economic Cooperation, and will be aimed primarily at industry.

Besides considering technical projects, the Conference will deal with matters of finance and organization.

New Automatic Radar Sighting System Unveiled

by Anthony Vandyk

LONDON—The Ferranti Airpass II radar fire-control and bomb aiming system was unveiled here last month. Designed for use in modern dual purpose interceptor/strike aircraft, it was developed as a private venture by Ferranti Ltd. In Edinburgh, Scotland, where the original Airpass I is now in quantity production for the Royal Air Force's English Electric Lightnings.

• **Installation**—Airpass I is purely an interception system designed for the English Electric "Lightning." It consists of a very advanced Radar equipment and a sighting system, the Pilot's Attack Sight or P.A.S. This is a "head-up" gyro sight designed for both visual and "blind" attacks and an identical sighting head is used in Airpass I. The Airpass II radar also has many similar features. In particular the principle of a self-contained inter-changeable nose-pack is retained, saving weight and simplifying front-line servicing.

Airpass II provides for largely automatic navigation and weapon-aiming by day or night on interception, ground-support or long-range strike missions yet the size and weight are little more than those of Airpass I. Airpass II can be installed in most interceptor and strike aircraft and has been specified for the export versions of the English Electric "Lightning," the Dassault "Mirage III" and the SAAB "Draken."

• **Interception**—The radar, which is stabilized in pitch and roll, scans a sector of sky covering a wide angle in elevation and azimuth on either side of the flight path and extending many miles ahead of the fighter. Once a target is located and seen on the Search Display the radar is locked-on and begins to track. This process can also be initiated, of course, if a target is detected visually.

Once the scanner has locked-on, a computer in the radar Unit automatically works out the best approach course for the pilot to follow in order to reach a suitable position for attack with guns, rockets or guided weapons. Steering signals from this computer are presented on the Pilot's Attack Sight in the form of an Aiming Mark and Target Spot.

On completion of the approach the P.A.S. automatically ensures that the weapons are correctly aimed even though the target may be still invisible to the pilot. At the same time the attack can easily be completed visually if the target should come into view, since the pilot is already looking forward out of his cockpit through the sight. An automatic warning lamp is also incorporated on the side of the P.A.S. to tell the pilot when to break off the attack if he should approach close enough to be in danger of colliding with the target.

• **Air-To-Surface Attacks**—In good visibility all types of surface target may be attacked with guns, bombs or rockets using the Pilot's Attack Sight for aiming, with target range being fed automatically from the radar. Certain targets such as ships, which return a clear radar echo, can also be attacked "blind." Conventional bombing is by the "dive-toss" method, but if it is required to make prepared attacks against targets whose position is known, Airpass II can be provided with a Navigation Computer and Bombing Computer designed for "long-toss" bombing. Alternatively for visual attacks the pilot can fly directly over the target and use an "over-the-shoulder" bombing maneuver.

In all bombing attacks the correct aircraft path is calculated in the Bombing Computer and steering signals are presented on the Pilot's Attack Sight. These allow the pilot to maintain the required course during the bombing run, taking account of any corrections necessary for wind and aircraft speed. These corrections are fed in from Doppler radar if this is available or the wind data can be estimated by the pilot and pre-set on his switch panel.

• **Navigation And Low Flying**—The Approach to surface targets will often be made at very low level beneath the coverage of ground radars. Airpass II has, been designed to be capable of giving the maximum help in navigation and low flying.

In the Ground Mapping mode the radar scanner is stabilized in pitch and roll and the pilot sees a P.P.I. radar map of the terrain ahead on his Search Display. He can compare this with his normal map and check his navigation even if he cannot see the ground. In addition, if the Navigation Computer is carried this can identify the target and provide steering signals to it for presentation on the P.A.S. display.

In the Contour Mapping (or Terrain Avoidance) mode the radar scans to and from on either side of the aircraft's flight vector. The radar Search Display shows also any hills scanned by the radar beam.

Lockheed Missile Business Up

More than half Lockheed Aircraft Corp.'s $1.3 billion business in 1960 came from missile and space business, underscoring the current trend in the aerospace industry.

Thirty percent of 1960 sales came from *Polaris* ballistic missiles, according to a year-end report by Chairman Robert E. Gross. Gross also disclosed that the first launchings of the extended range *A-2* and *A-3 Polaris* models will take place this year.

Agena satellite vehicles and other space research brought more than 22% of the company's business for the year. Lockheed noted that it has orders which will bring the number of *Agena* satellites in 1961 to more than those orbited by the United States and USSR combined in 1960.

The company forecast new uses for *Agena* in Project *Advent*, and in *Saint*, an Air Force project being directed by RCA for inspection of unidentified satellites.

Aircraft's portion of Lockheed's total sales show a steady decline from 94% in 1955 to 43% in 1960. All missile sales at Lockheed five years ago accounted for less than 4% of total business.

Martin Company—The missile and space company disclosed that record sales and earnings will probably be reported for 1960 and that 1961 sales will probably continue the trend.

The company, which recently moved out of the aircraft business by delivering its last P5M-2 to the Navy, has in production *Titan, Pershing, Mace, Bullpup* and *Lacrosse*.

Emerson Electric Mfg.—Highest sales and earnings in the history of the company were reported for the fiscal year ended Sept. 30. Consolidated sales were $125.5 million, including sales of $24.5 million of Day-Brite Lighting for the full fiscal year. This compares with sales of $91.5 million for the previous year when Day-Brite was not a subsidiary. Earnings were $6 million, with almost $1 million attributed to Day-Brite. Net earnings the previous year totaled almost $4 million. Sales of defense products totaled $41.6 million, an increase of 21% over sales of $34.2 million the previous year.

Yardney Electric—Six-month sales reached $4.8 million, compared to $3.3 million for the same six months of 1959.

Bendix Corp.—Sales, royalties and other operating income for the 1960 fiscal year ended Sept. 30 were $792.3 million—15% over the previous year's total of $683.8 million. Net income amounted to $26.2 million compared with $27.4 million in 1959.

CENTAUR BOOSTER (center) goes into final assembly at Convair's San Diego plant amid conventional Atlas airframes. Atlas-Centaur vehicle, which will be flight tested this year, holds more fuel because of untapered configuration.

Corporate Changes

RADIATION INC. has changed the name of its subsidiary Levinthal Electronic Products, Inc. to Radiation at Stanford. Radiation at Stanford will combine the activities of Levinthal Palo Alto, and Radiation's Space Communications Division presently at Mountain View. The company's Palo Alto facilities will be expanded to accommodate the Mountain View division and increased West Coast operations.

STRATHAM DEVELOPMENT CORPORATION, a wholly owned subsidiary of Statham Instruments, Inc., has been merged with the parent company and will be known as the Electronics Division.

BURTEK, INC. has acquired Concord Control, Inc., of Boston from the Giddings & Lewis Machine Tool Co. of Fond Du Lac, Wis., and the officers of Concord.

CALIFORNIA EASTERN AVIATION through its subsidiary Land-Air, Inc., has acquired Automation Controls Corp. Automation Controls has been integrated into the Steppers Motors Division of Land-Air.

DORSETT ELECTRONICS LABS, INC. has purchased all the outstanding shares of American Missile Products, Inc. of Lawndale, Calif. American Missile formerly was the electronics division of the Maytag Company, Newton, Iowa.

WESTINGHOUSE ELECTRIC'S aircraft equipment department located at Lima, Ohio, has been renamed the Aero-space department. The group has been active in the space field for about two years.

DEFENSE INFORMATION INC.'s Undersea Technology Department has formed a Anti-Submarine Warfare Technical/Management Directory Service listing the technical, functional or operational responsibilities of more than 300 desks in Washington, D.C., concerned with undersea technology. Donald E. Perry, former managing editor of MISSILES AND ROCKETS, heads the department.

DOW CHEMICAL CO.'s Industrial Service Division has formed a "missile task force" to coordinate all chemical cleaning of missile system components. The cleaning facilities had been supervised by three separate district offices which also had responsibility for chemical cleaning operations in strictly industrial applications.

GENERAL ELECTRIC has dedicated its new $8-million Syracuse Industrial Center Plant. The ultra-modern 465,000-sq.-ft. engineering and manufacturing facility will be used by the company's Heavy Military Electronics Dept.

MOTOROLA, INC. has moved into new corporate headquarters in Franklin Park, Ill. The new $7.5-million structure will house the company's corporate executive offices in addition to its Consumer and Automotive Products divisions with their respective engineering, developmental and research facilities.

CONVAIR DIVISION of General Dynamics Corp. is moving its Dynapak facility from Pomona to San Diego this month. The facility manufactures high-energy rare metal-forming machines and a line of advanced mechanical test equipment.

TEMESCAL METALLURGICAL CORP. has moved its offices and plant from Richmond, Calif., to a new location at Berkeley. The company has a new electron beam furnace under construction at the Berkeley site which will stand approximately three stories high and will weigh nearly 25 tons.

ROCKETDYNE DIVISION of North American Aviation, Inc., has established a separate subdivision for reliability in Liquid Propulsion Operations. Dr. C. C. Davenport will direct the program.

WYMAN-GORDON CO. has almost completed a $3 million expansion of beryllium facilities with the enlargement of present processing quarters. Transfer of precision forging equipment to Worcester, Mass. from Franklin Park, Ill. is almost completed.

NORTH AMERICAN AVIATION has changed its Missile division to Space and Information Systems division. At the same time the division will accelerate the development of the *Hound Dog* and more of the corporation's work on manned and unmanned space exploration vehicles, anti-ICBM projects and management of information processing systems will be concentrated there. Some 25 or 30 persons from other company space projects will join the 6400 employees who have been in the division.

THOMPSON RAMO WOOLDRIDGE has obtained an option to acquire more than 90% of Radio Condenser's common shares through a stock exchange. The acquisition would add a completely new product line to TRW's Electronic Components Group.

ELECTRONIC MATERIALS CORP. has been formed to prepare and conduct research and development studies in advanced materials for Space Age technology. The Santa Monica firm will be headed by Dr. R. C. Vickery and H. M. Muir.

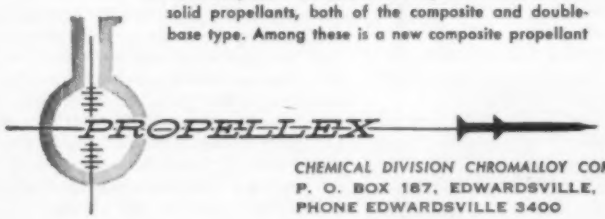
CRYOMETRIC CORP. has been organized in La Jolla, Calif., to specialize in instrumentation needs in the field of cryogenics. The firm will have an R&D laboratory in Los Angeles and subcontract initial manufacturing to another firm.

BULK ORGANIC NITRATES

- **PGN** ... polyglycidyl nitrate
- **TEGDN** ... triethylene glycol dinitrate
- **PeTriN** ... pentaerythritol trinitrate
- **TMETN** ... trimethylol ethane trinitrate
- **BGDN** ... butylene glycol dinitrate
- **DEGDN** ... diethylene glycol dinitrate

The above explosive and high-energy plasticizers for solid propellants are now available (in any quantity) from Propellex. In addition, Propellex manufactures solid propellants, both of the composite and double-base type. Among these is a new composite propellant that combines high energy with extremely low sensitivity to temperature changes.

For nitrated chemicals, propellants, explosive and ignition materials, plus other specialty chemicals . . . contact Propellex. Prices on request.



CHEMICAL DIVISION CHROMALLOY CORPORATION
P. O. BOX 167, EDWARDSVILLE, ILLINOIS
PHONE EDWARDSVILLE 3400

IMMEDIATE DELIVERY

WEST COAST OFFICE:
4609 Staunton Avenue
Los Angeles 58 • ADAMS 2-6191

Circle No. 10 on Subscriber Service Card.

CD controversy . . .

Hoegh Disputes Military 'Takeover'

Novelist Pat Frank's description of the state of the nation's civil defenses in M/R last month prompts a sharply worded rebuttal from retiring CD Director Leo Hoegh, who feels Frank is dead wrong. For an answer to the rebuttal and some reader comments see next page and page 48.

PAT FRANK'S SUCCESS as a "nuclear war" novelist is due to his knowledge of the subject and his vivid imagination. But in some opinions expressed in his article on civil defense ("Kennedy Should Put Civil Defense Under Military," M/R, Dec. 12, p, 16), I think he's wrong. This is why:

1. He implies that, under the Symington Plan (Report to Sen. Kennedy from the Committee on the Defense Establishment), all of civil defense would be placed under the military. This is apparently mere conjecture. The report said: "There should be established a unified Command in charge of the National Guard and Reserve elements of all of the Services. In addition to its other functions, this command would be responsible for Civil Defense, and would report directly to the Chairman of the Joint Staff." According to its Executive Director, Dr. Edward C. Welsh, the Committee meant to suggest by this only that *military activities* regarding civil defense should be strengthened and centralized. No decision was made, he says, regarding a takeover of civil defense by the military. He acknowledges that policy direction would certainly have to come from outside the Pentagon.

2. If any reorganization does come about, it is unlikely to ignore the views of the military. On *direction* of civil defense, the military position has long been clear: Defense has a primary mission—combat. The question of who should direct civil defense is not new. The function was taken out of the War Department during World War I and was under civilian control in World War II. In 1948 the War Department's Civil Defense Board stated flatly that the major civil defense problems are outside the scope of military responsibility because "such problems are civilian in nature and should be solved by a civilian organization which would plan, operate and supervise civil defense in all of its phases." Such a civilian organization was eventually created, and these functions now are performed by the Office of Civil and Defense Mobilization, part of the Executive Office of the President. The military agrees that this is a proper assignment.

This does not mean there is no place for the armed forces in civil defense *operations*. The role of the military, explicity spelled out in Annex 7 to *The National Plan for Civil Defense and Defense Mobilization*, and in DOD directives, is that "military support to civil authorities in civil defense operations is an emergency task within the mission of all Federal active duty and reserve units of the military services, to be performed when essential military requirements will permit." The Commanding General of the U.S. Continental Army Command has emphasized this role, and the necessary training for it, to the army commanders. These policies now appear in the Supplement to the Army Strategic Capabilities Plan.

Assistant Secretary of Defense Charles C. Finucane, in a DOD policy statement before the House Military Operations Subcommittee this past April, declared, "Civil defense must remain under civil authority in accordance with the policy and intent of the Congress expressed in the Federal Civil Defense Act of 1950 as amended."

"Military assistance," he added, "is complementary to but not a substitute for civil participation in civil defense. It would, therefore, be extremely hazardous to assume that the military could meet a substantial share of the civil defense requirements while simultaneously conducting necessary military operations. An effective civil defense plan must include the civil population at large in civil defense operations to assure the survival of the Nation and its military power."

3. There is much more to civil defense today than patching up people and their property after an attack while maintaining some semblance of order—and even that would be too big a task for the military. It is prepared to help, but it recognizes the impossibility of doing the job alone. Much more suitable are the seven millions of government employees —Federals, State and local. It has long been our aim to make full use of government personnel and resources in emergency.

Also, civil defense involves preparing the people to protect themselves against attack, insuring the capability of government to function, safeguarding the people's rights, preserving and allocating resources, maintaining an adequate economic system. This is the business of all government, not just the military.

4. "In the event of nuclear attack on the United States," says Mr. Frank, "martial law would be declared instantly, so in a crisis civilian defense would be subordinated to the military in any case." This presumption ignores the effects of current preparations for strengthening continuity of government at all levels in order to avoid the necessity for imposing martial law. The military would give priority to support of civil authorities in maintaining law and order.

The term is not universally understood. Martial law is a last resort, not an automatic act; it cannot be imposed without specific executive authorization. And no one is more wary of its consequences than the military.

5. Turning from organization to activities, Mr. Frank asserts: "Drastic revision of present civil defense tactics must take place to give the people a realistic hope for survival." One such "drastic revision" he proposes has been national policy for two and a half years: "an adequate home shelter program, privately financed with Federal encouragement."

The "National Policy on Shelters" statement, issued at the President's direction on May 7, 1958, declared that "in the event of nuclear attack on this country fallout shelters offer the best single nonmilitary defense measure for the protection of the greatest number of our people." To implement this policy, OCDM has been educating the people on attack effects and protective measures (for example, millions of family fallout shelter plans have been distributed), surveying existing shelter, constructing prototypes for public inspection, and developing even better shelter techniques. Leadership and example through inclusion of fallout shelter in new and existing Federal buildings have been stymied by the almost total failure of the Congress to appropriate funds. This is one indication of the responsibility for what Mr. Frank calls "the budgetary brushoff given Civil Defense."

6. While his emphasis on shelter is commendable (if not original), his disdain for evacuation does not logically follow. At the right time and the right place, evacuation may be the best course. As long as it may save lives, it must remain a possible alternative to shelter. Also, it is not necessarily a matter of choice between the two; a combination of them may be best. At any rate, the action to be taken is a local decision, for the local authorities alone can weigh all of the many factors involved. Until an area has enough shelter space, and perhaps even then, it may be wiser, if time permits before an expected attack or arrival of fallout from an attack upwind, to move to a relatively safer place. Civil defense planning rightly stresses shelter, but not to the exclusion of evacuation.

7. Among his other proposals is one to scrap the Conelrad plan for reducing navigational aid to the attacker by re-

stricting emergency broadcasting. Contrary to Mr. Frank, the Air Force maintains that, since bombers would probably be used even in a so-called missile attack, Conelrad is still needed. Further, the system is steadily being improved so that everyone will be in range of instructions broadcast during the attack period over 640 or 1240 kc on AM radio.

8. As for the vulnerability of wire service facilities and its effect on dissemination of news, the situation is again not so bad as pictured. NACOM 2, the Government's National Radio Communications System, provides backing for landline communications (NACOM 1) at all OCDM and State operational headquarters. This would be available to news media, subject to higher priority needs of government.

9. Mr. Frank's comments on the reasons behind public "unalarm" are apt, but his view of the extent of this apathy is exaggerated. He ignores the great and increasing number of citizens who participate in local civil defense activities, who inquire about what they should do and how they can help, and who have built fallout shelters and taken other recommended survival measures.

There are *no* "policies designed to play down the horrors of nuclear war," as should be evident from the vast amount of information OCDM and other agencies have made available and actively sought to get to the people. Apathy stems less from ignorance of the facts than from the desire to ignore those which are unpleasant. To say that the government has attempted to encourage this attitude is totally unfounded.

10. One last point, of lesser importance, perhaps, compared with these others, but nonetheless deserving of mention: the integrity and capability of those entrusted with these aspects of national defense. Mr. Frank does a disservice to these men and women, dedicated to their country and fully cognizant of the importance of their work.

I hope you will grant space in your publication for this presentation of "the other side" to Mr. Frank's story.

Leo A. Hoegh
Director
Office of Civil and Defense Mobilization
Washington

FRANK'S REPLY TO HOEGH

MR. HOEGH SAYS that I have a vivid imagination. I hope so. It has been the absence of imagination in the highest levels of government, as well as lack of appropriations, that is responsible for our supine civil defense. Mr. Hoegh ignores the one terrible fact implicit in all-out nuclear war: The primary target of the enemy would be the United States and its people. Therefore the protection of the people becomes a primary responsibility of the military.

The present Civil Defense setup, as Mr. Hoegh points out, was based on a 1948 Defense Department decision that "major civil defense problems are outside the scope of military responsibility." In 1948 the Russians had not yet ex-

(Continued on page 48)

INERTIAL QUALITY

SINGLE AND 2 AXIS ACCELEROMETERS

Highly precise and accurate, Kearfott's accelerometers are pendulous devices which sense airframe acceleration forces acting on them.

A pendulum utilizing a unique Hooke's joint suspension displaces as a function of acceleration. An AC pickoff signal is rectified and applied to voice coils restoring the pendulum to null. The DC required for restoration is proportional to acceleration. Typical characteristics for these units include range of ±25 g's, scale factor of 5.0 ma/g, linearity of ±0.005% and threshold of 2 x 10^{-7} g's.

CHARACTERISTICS:

	SINGLE AXIS	SINGLE AXIS	TWO AXIS
TYPE NO.	F2401	429037	326778-1
Range of Measurement	±20g	±25g	See above
Scale Factor (output)	5.0000 ma/g	5.0000 ma/g	
Operating Temperature	155°F ±5°F*	50°F and +160°F	
Threshold	5 x 10^{-7}g	Less than 2 x 10^{-7}g	
Zero Stability	±0.05 milliradian	±.00005g day to day	
Vibration	Up to ±10g peak from 20 to 2000 cps	Up to ±5g peak from 20 to 2000 cps	
Storage Temp.	−65°F to +200°F	−60°F to +170°F	
Scale Factor Variation	±.01% randomness	±0.01% randomness	
Excitation	6 volts, 3360 cps**	6 volts, 4000 cps**	3.4 volts, 4000 cps***
Natural Freq.	180 cps	210 cps	160 cps
Freq. Resp.	Flat to 250 cps	Flat to 160 cps	Flat to 100 cps
Shock	60 g's	30 g's	30 g's
Weight	4 oz.	7 oz.	2 lbs.

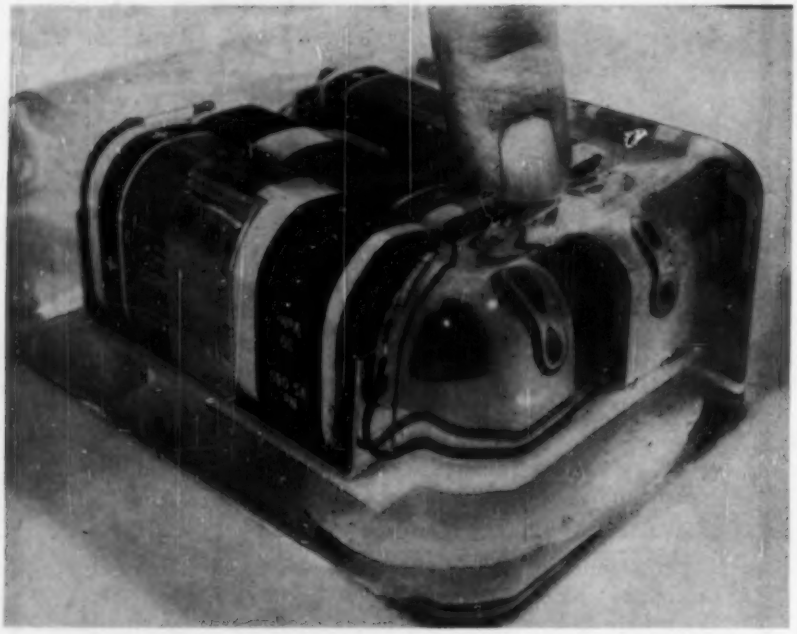
*Available for 180°F.
**Carrier frequency to 100 Kc may be used.
***When tested with Kearfott A3501-01 amplifier.

Write for complete data

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

Circle No. 11 on Subscriber Service Card.



Clear Silicone Plotting Compound

A clear silicone potting and embedding compound that provides mechanical and dielectric protection for electronic components is available from the Silicone Products Dept. of General Electric. Designated LVT 602, it cures at 70° to 80° C to a flexible solid.

LTV-602 provides protection against shock, vibration, moisture, ozone, and other environmental hazards of the space age. The cured material is self-supporting and non-flowing, providing for ease of handling as well as continual exclusion of dust and other contaminating particles.

Because of its low viscosity in the uncured form (800 to 1500 cp), LTV-602 flows freely in and around complex parts. Delicate components are not damaged by stress during cure.

Circle No. 225 on Subscriber Service Card.

Ceramic Fiber Insulation

Fiberfax (R) ceramic fiber, a high temperature insulation, is available from the Carborundum Co.

The fibers are fabricated into over 40 forms such as blocks, sheets, paper, textiles, blankets, rope, castables and moulded forms. The light material withstands continuous operating temperatures up to 2300° F.

Circle No. 226 on Subscriber Service Card.

Dual Liquid Head Valve

Variable system pressures do not affect the function of a differential-level pilot valve available from Besler Corp. The valve operates on the difference between two columns of liquid, usually between a constant reference head and a variable head.

As the level rises in the variable column the Besler differential level pilot valve opens and releases air pressure from the top of a diaphragm motor valve, allowing the discharge of liquid from the variable column. When the level in this column falls to a pre-determined level the valve again closes, and the cycle repeats.

Circle No. 227 on Subscriber Service Card.

Skidless Surface Measure

Because of the increased demand for equipment capable of measuring surfaces too small to permit both the pickup skids and diamond stylus to be located on one part, Cleveland Instrument Co. is marketing skidless pickup models designed to measure very narrow or small areas, such as flanges, thread flanks, gear teeth, and small internal diameters, as well as "O" ring grooves.

The Model BK 3922F Precision Slide makes possible surface measurements without skids—the reference line, normally provided by the skids being generated by the slide.

Model MP 0002SL General Purpose Skidless Pickup is for the measurement of small I.D.'s and O.D.'s, flanges, thread flanks, gear teeth, or other applications where limited area measurements exist. With this equipment measurements can be made to within 0.020 in. of the shoulder.

Circle No. 228 on Subscriber Service Card.

High Capacity Data Switch

Through the use of printed circuits and modular type construction, Instrument Systems Corp. has developed a compact high capacity data switch for multi-contact temporary or permanent switching. A representative model has 40 single-pole switches, each of which can be manually positioned to select one of 56 contacts on glass fiber laminated printed circuit boards.

Circle No. 229 on Subscriber Service Card.

Test Table Leak Detector

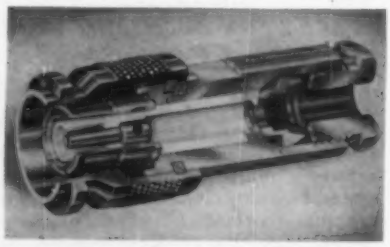
A test table designed to make production leak detection a fast, foolproof operation is available from General Electric for mass spectrometer leak detectors.

An accessory that attaches directly to the mobile G-E leak detector, the unit is intended to expedite production testing of capacitors, transistors, vacuum tubes, and nearly any other large or small device when minute leaks must be detected.

Circle No. 230 on Subscriber Service Card.

R. F. Connectors

Designed for use with small size coaxial cables, such as RG-59B/U, a series of AN/MS Type connectors



developed by National Connector Corp. uses irradiated polyolefin and polypropylene. Weatherproofed and designed for extreme reliability, even under abnormal conditions of stress, NCC's AN/MS series connectors may be efficiently used up through microwave frequencies with a minimum of line unbalance or increase in standing wave ratio. Unique design permits the

coax conductor to be soldered directly to the contact point within the connector body, greatly reducing the danger of accidental disconnection due to cable strain.

Circle No. 231 on Subscriber Service Card.

Environmental Chambers

Conrad, Inc. has available four standardized production models of space environment test chambers. The sizes are 72, 48 and 36 in. diameter by 60 in. deep and 24 in. diameter by 30 in. deep. The chambers feature various accessory items such as rotary shafts, interior lighting, view ports and optional stainless steel liners. The chambers are equipped with mechanical and diffusion pumping systems. Pumping time, to 0.5 of a micron, range from 3½ minutes to 8 minutes depending on the chamber size. Higher vacuums are available on special order.

Circle No. 232 on Subscriber Service Card.

Tunnel-Diode Oscillators

Two stable microwave oscillators utilizing tunnel diodes in specially designed circuits are available from Radio Corporation of America.

The SS-100 is mechanically tuned over its 1050-1400 Mc range. The center frequency of the SS-104 is specified by the user in the 800-1400 Mc range. It can be electronically tuned over a total range of 5% of its center frequency by varying the dc input voltage.

Circle No. 233 on Subscriber Service Card.

Broadband Isolator

A broadband isolator providing minimum isolation of 30 db with a maximum VSWR of 1.10 and a maximum insertion loss of 1.0 over the entire X-band frequency range, from 8.2 to 12.4 Kmc/S, is available from E & M Laboratories.

Circle No. 234 on Subscriber Service Card.

Al-Si Rubber Glass Cloth

Protection of equipment and personnel from high radiated heat is possible with an aluminized silicone rubber coated glass cloth available from the Irvington Division of Minnesota Mining and Manufacturing Co.

"Irvington" brand aluminized fabrics SRGA 0208 and SRGA 0214 are 0.008 and 0.014 inches in caliper, weigh 10 and 14 oz./sq./yd. respectively, are suitable for use in continuous ambient temperatures ranging from —100° to 500°F., and for short periods of 700°F. The fabrics are available with the plain silicone rubber coated side either cured or uncured. Special treatment makes it possible to bond either side under heat and pressure for applications where this is desirable.

Circle No. 235 on Subscriber Service Card.

Magnetic Storage Drums

Instrument Systems Corp. is marketing magnetic storage drums. A typical item includes 4 channels, two of which provide adjustable delays of up to 6 seconds accommodating either complex waves or pulses. The unit utilizes a synchronous drive motor and special hydraulically damped gear box which results in smooth and uniform drum motion.

Circle No. 236 on Subscriber Service Card.

Speed Sensitive Switch

The Cosmodyne Corp. is manufacturing a wide temperature range, speed sensitive switch S-10. Rated performance for the unit is a switching error not to exceed 1.5% of the rated speed over all environmental conditions. The unit may be supplied with as many as three either normally open or closed switched allowing for as many as three speed settings.

Circle No. 237 on Subscriber Service Card.

Frequency Converter Units

A versatile plug-in unit which increases the measuring capability of -hp- Model 524 Electronic Counters to 510 MC is available from Hewlett-Packard Co. Model 525C contains a capacity-loaded cavity for frequency determination and a highly-efficient diode harmonic generator plus a transistorized amplifier. A "go-no-go" meter on the front panel shows when the signal has enough amplitude for frequency measurements.

Circle No. 238 on Subscriber Service Card.

Telephone Data Transmission

Digitronics Corp. has available a Dial-o-verter System, operating in connection with the Bell System's Data Phone 200 subset, makes possible the rapid transmission of punched card paper tape or magnetic tape data over regular toll telephone lines. With the instrument, as many as 27,000 alphanumeric characters can be sent during a three minute phone call.

Circle No. 239 on Subscriber Service Card.

Radiation Analysis

A transistorized spectrometer which automatically distinguishes between background radiation and the radioactivity of the object being analyzed is available from the Victoreen Instrument Co. The instrument has 200 data storage channels with total capacity of 20 million "counts."

Circle No. 240 on Subscriber Service Card.

Male Port Metering Valve

A small globe type metering valve with male ports, 14,000 psi burst pressure, suitable for manometer pressure gauge or sampling use with gases such as air, nitrogen, oxygen, and helium is being marketed by Robbins Aviation, Inc.

The INS736 has an operating torque of 4 in.-lbs. at 2500 psi. Operating temperature range is –65° to 250° F. Weight is only 0.31 lbs.

Circle No. 241 on Subscriber Service Card.

Projection Resistance Welder

The ability to encapsulate semi-conductor and transistor components by resistance welding over a wide range of sizes on one piece of equipment has been achieved by the Thomson Electric Welder Co. with their Model 2400 projection welder. This capacity range is realized by using twin 75 KVA transformers coupled to the welding head through balanced secondary circuits and a new welding head design.

Circle No. 242 on Subscriber Service Card.

Telephone Circuit Tester

The Siegler Corp. has available an electronic instrument which can test telephone circuit signals with 14 times the efficiency of conventional methods.

The device is called a Swept-Band Transmission Measuring Set. It discloses if there is any defect in a telephone circuit. In some cases, the Swept-Band can also determine the type of defect and its location.

It requires 6 minutes to examine one telephone circuit by manual methods. The Swept-Band can test 14 circuits in the same time period.

Circle No. 243 on Subscriber Service Card.

Parametric Amplifiers

A family of broadband, Mil Spec parametric amplifiers for applications at L. S. C and X bands is available from Texas Instruments. Among these is an S-band non-degenerate Model that gives bandwidths up to 75mc at 15 db gain.

The extra wide bandwidth has been achieved by double tuning of amplifier idler circuits. Noise figure, including

circulator loss, for the S-band model is 3 db over the frequency range of 2.8 to 2.96 Gc; gain variation is no greater than 3db over the Mil-spec temperature range of —40° to 50° C. The unit also meets the vibration requirements of MIL-E-5400D.

Circle No. 244 on Subscriber Service Card.

Flexible Twin DC Supply

Two low voltage DC power supplies with floating outputs, are available from R-K Labs. One supply offers 2, 6, and 12 volts d.c., selectable. The other, 1-30 volts d.c., variable. Both at 200 ma. Output may be used separately or simultaneously. Case grounded panel terminal offers choice of grounding either positive or negative outputs of both supplies.

Circle No. 245 on Subscriber Service Card.

Fast Plaster Tooling

A material and method for producing short run, low cost plastic faced plaster tooling in two hours or less is available from Rezolin, Inc.

The simple four-step procedure utilizes Rezolin 111 Surface Coat Compound, which permits continuous rapid fabrication with no drying or waiting between steps. End tool will operate at temperatures up to 385° F.

Circle No. 246 on Subscriber Service Card.

Adjustable Sequence Timer

Acton Laboratories Inc., a subsidiary of Technology Instrument corp. is marketing a miniature adjustable sequence timer Model 4-23. The lightweight timer features micro adjustable cams that can quickly be set within 0.1% of the total period.

The adjustable time span is 1 second to 45 minutes. The timer will provide switch closures during and after powered flight. The current drain is less than 70 milliamps.

Circle No. 247 on Subscriber Service Card.

Ceramic Capacitor

A Glenco micro-miniature ceramic capacitor, believed to be the smallest capacitor commercially available, is being marketed by Gulton Industries, Inc.

Maximum size of the capacitor is 0.1-in. square by 0.05-in. thick, with a rating of 30 WVDC. Capacitance values are available in the range from 10 to 220 mmf., with a maximum capacitance change of ±10 percent over the temperature range of –55° to 85°C.

Circle No. 248 on Subscriber Service Card.

Film Transducer

Clark Electronic Laboratories is marketing a chemical film transducer in the 0-5,000-lb. force size. This unit is 1 in. in diameter, and changes its electrical resistance from 0 to 5,000 lbs. over 100,000 ohms, with only 0.0005 in. deflection at full load.

These units will withstand temperatures from –150° to 450°F continuously, and vibration and shock of high magnitude.

Circle No. 249 on Subscriber Service Card.

Slab Shaped Delay Line

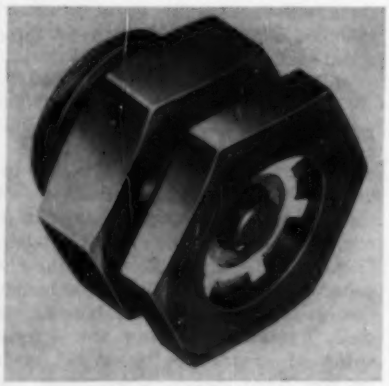
Deltime, Inc., has available a series of magnetostrictive delay lines, Type 158. They are of slab configuration to assist in high-density packaging of electronic equipment.

A maximum delay of 39 microseconds with up to nine additional outputs is available. Input pulse width is 0.8 microsecond with a maximum repetition rate of 625 kc. Insertion loss is approximately 50 db.

Circle No. 250 on Subscriber Service Card.

Vent and Breather Valve

A compact combination vent and breather valve, PI-309, is available from James, Pond & Clark, Inc. Designed for



simple, single-hole mounting, the PI-309 will efficiently eliminate damaging internal and external pressure differentials caused by changes of altitude. By preventing diurnal breathing, the valve effectively prevents formation of condensed moisture in the container.

Circle No. 251 on Subscriber Service Card.

Pressure Reducing Valve

Available in 4 and 6 in. sizes from OPW-Jordan Corp., a sliding gate and plate pressure reducing valve, air-operated, has capacity of 50,000 pounds of steam per hour or 2,500 GPM of water. Used to reduce pressure wherever large capacities, accurate control and tight shut-off are required, the system is suitable for pressures to 250 psi and temperatures to 500°F.

Circle No. 252 on Subscriber Service Card.

Semiconductor Centrifuges

Lourdes Instrument Corp., has available special centrifuge rotors with cavities cut to conform to exact contours of diodes, transistors, capacitors and other semiconductors.

Relative centrifugal forces from 10,000 to 25,000 times gravity are secured, subjecting components to some of the effects encountered in space travel. Test results are quick and reproducible.

Circle No. 253 on Subscriber Service Card.

Tungsten Arc Welder

A balanced wave, transformer type power source for use with tungsten arc welding equipment (Heliweld) is available from Air Reduction Sales Co. Designated the Airco C-Bee (capacitor balanced) Balanced Wave Heliwelder, this machine is exceptionally good for welding aluminum and magnesium using alternating current. It can be used with both manual and semi-automatic or automatic Heliweld equipment.

Circle No. 254 on Subscriber Service Card.

Sub-Size Thermocouple

A sub-miniature fast-responding surface thermocouple is available from NANMAC Corp. with an overall well length of only 1.5 in. making possible a new variety of applications.

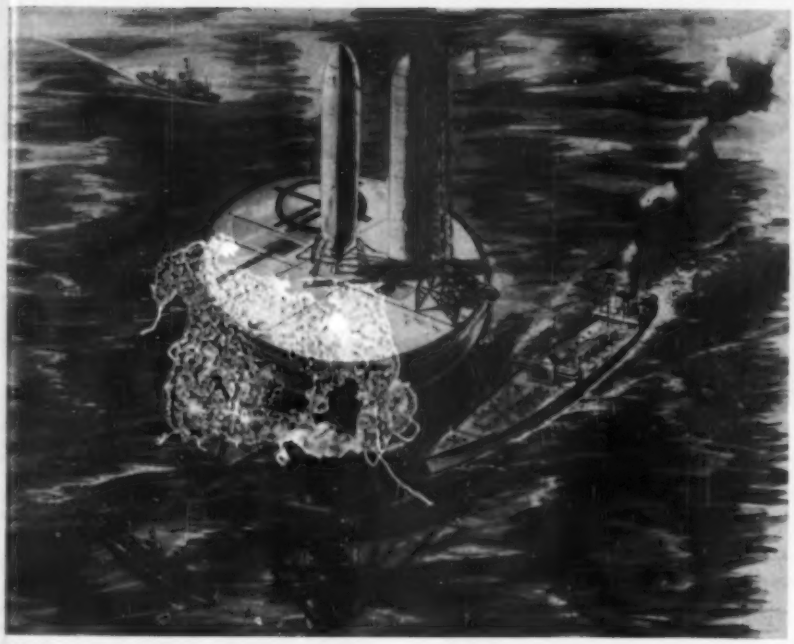
The thermocouple, Model D, features a response time of less than ten micro-seconds, a continuous service temperature of over 2000°F., an operating pressure range to 25,000 psi., and a sensing tip with unlimited life.

Circle No. 255 on Subscriber Service Card.

Constant Mass Fan

A fan and motor coupled by means of a patented constant torque magnetic device providing an essentially constant mass rate of air flow over the operational altitude range of the cooling equipment on which the assembly is applied is available from Eastern Industries, Inc. Based on the principle of decreasing density of air with increasing altitude, the coupling permits the fan speed to vary directly with altitude or inversely with the square root with relative density of the air being handled.

Circle No. 256 on Subscriber Service Card.



Seagoing Launchpad

NUCLEAR ROCKET ready to blast off from floating launch platform as proposed by Aerojet-General Corp.'s AETRON Div. PROP (Planetary Rocket Ocean Platform) would be serviced by supply ships and submarine to evacuate personnel during nuclear activity.

Solar Storm Changes Orbit of NASA's Echo I Satellite

A great solar storm Nov. 12, the most severe since Feb. 23, 1956, produced a substantial change in the orbit of the 100-ft. *Echo I* balloon satellite.

Calculations by NASA's Goddard Space Flight Center indicate that atmospheric drag acting on the satellite increased by a factor of two for several days, during which time the orbital period was increased two seconds a day. Then the drag fell back to its previous level.

Dr. Robert Jastrow and Robert Bryant of Goddard's Theoretical Division, who made the calculation, indicated that the most likely cause of the drag increase is an increase in the average density of the very thin air through which the satellite moved, produced by the heating and subsequent expansion of thicker air at lower altitudes.

When launched Aug. 12, *Echo I* had a perigee of 945 statute miles and an apogee of 1049 miles. Currently, it has a perigee of 619 miles and an apogee of 1334 miles. Even though the atmospheric drag is extremely tiny at those altitudes, the effect is measurable on an object like *Echo*, which has a huge surface and weighs only about 150 lbs. ⌗

STL Wins First Contract For Large NASA Satellite

Space Technology Laboratories, Inc., steadily moving free of its Air Force management commitments, has won its first major contract—for research and development of a big standardized satellite for the National Aeronautics and Space Administration.

The initial contract, for delivery of three flight spacecraft within three years, will total more than $15 million. However, NASA plans call for flying one or two Orbiting Geophysical Observatory (*OGO*) satellites a year for the succeeding five years. Thus follow-on contracts could bring the total to more than $50 million over an eight-year period (M/R, Sept. 12, p. 10).

OGO will weigh 1000 lbs., including up to 50 scientific experiments in modular sections, weighing 150 lbs. The design includes a potential of growth to 1500 lbs., including a 300-lb. piggyback satellite.

The spacecraft is designed for use with *Atlas-Agena B, Thor-Agena B* and *Centaur* launch vehicles. The first launching, programed for September, 1963, will be the Eccentric Geophysical Observatory (*EGO*), designated S-49, aboard an *Atlas-Agena B* down the Atlantic Missile Range. Nominal *EGO* orbital parameters will be: inclination 31°, perigee 150 nautical miles, apogee 60,000 nautical miles.

The second mission, programed for June, 1964, will be the first Polar Orbiting Geophysical Observatory (POGO), launched by a *Thor-Agena B* down the Pacific Missile Range, with a perigee of 150 nautical miles and an apogee of 600 nautical miles.

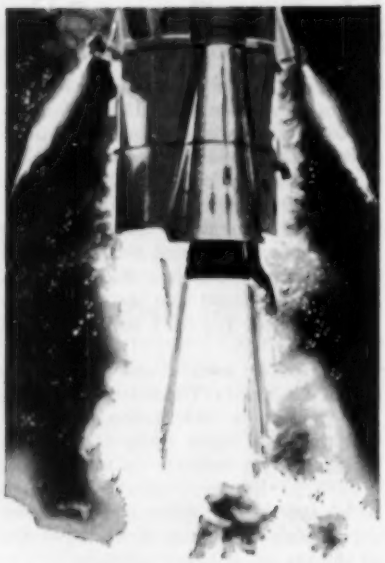
The satellite will be a rectangular parallelopiped about the size of a small coffin, six feet long and three feet square. Solar paddles six feet square and storage batteries will provide about 50 watts of power for experiments.

NASA hopes to fly *OGOs* on a "train schedule" basis, so that scientists preparing experiments will merely have to reserve space on the next satellite and deliver them to the launch site on time. This will greatly reduce the lead time built into early satellites, which had to be custom built.

NASA's Goddard Space Flight Center, Greenbelt, Md., will negotiate and manage the contract. Wilfred E. Scull of Goddard is project manager. Project scientists are Dr. George H. Ludwig for *EGO* and Nelson W. Spencer for *POGO*.

STL was chosen from eight bidders. The others were Aerojet-General, Bendix, Convair, General Electric, Grumman, Lockheed and RCA. ⌗

New
LIGHTWEIGHT
SOFAR BOMB
FOR RE-ENTRY
VEHICLE LOCATION
• Weighs 30% less than prior models of SOFAR bombs
• Much more compact
• High reliability factor
• Impervious to "g" forces
• Absolute 3-stage safeing
• Hydrostatic actuation
• Non-destructive testing and calibration
• Lower in cost
Ask for complete performance data. And you're invited to consult with the capable, experienced research and development staff at MIMX on any special ordnance problems involving actuation, location or recovery components for the missile or orbital fields . . . also for "plastics with memories."
MIMX CORPORATION
1505 Gardena Avenue
Glendale 4, California
CHapman 5-1883
mimx
TRADE MARK
Circle No. 12 on Subscriber Service Card.



R/M ASBESTOS-PHENOLICS

...rewriting the book on thermal protection

Reinforced plastics make it possible to design parts that will withstand 10,000°F. At heats where other materials fail suddenly, reinforced plastics ablate uniformly.

R/M asbestos-phenolic parts are used on virtually every U.S. missile. They exhibit a highly desirable combination of properties such as low thermal conductivity and diffusivity, low rate of ablation, high strength-to-weight ratio, excellent shock resistance and structural integrity.

Asbestos-phenolic felts, mats and molding compounds are available for prompt shipment from R/M in production quantities. And they are backed by comprehensive technical data and know-how. Write for information and engineering help.

Tape wound rocket motor tube liner of R/M Style 41RPD Pyrotex.®

RM

RAYBESTOS-MANHATTAN, INC.
Reinforced Plastics Department, Manheim, Pa.

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

Circle No. 13 on Subscriber Service Card.

contracts

NASA

General Electric's Missile and Space Vehicle Dept., an R&D contract for investigation of a means to store heat energy collected from the sun. The energy is needed to supply electrical power in satellites while they pass through the dark portion of their orbits caused by the earth's shadow. Amount not disclosed.

$50,155—Chance Vought Aircraft, Inc., Dallas, for sounding rocket study.

NAVY

$2,500,000—Raytheon Co., Waltham, Mass., for industrial support to MIT in design and development of the *Polaris* inertial guidance system.

$1,400,000—Genge Industries, Inc., Los Angeles, for engineering services, technical publications and documentation in support of NOTS.

$83,000—Benson-Lehner Corp., Santa Monica, for design and manufacture of a high speed stereo camera and projection system for the Naval Weapons Laboratory.

AIR FORCE

$3,000,000—Motorola, Inc., Chicago, for microwave radar relay systems for 22 Air Force bases.

$620,000—Avien, Inc., Woodside, N.Y., for limit detectors for the *Hound Dog* missile. Subcontract from **North American Aviation, Inc.**

$597,052—Lockheed Aircraft Corp., Burbank, for ejectable nose capsule program.

$130,000—Giannini Controls Corp., Duarte, Calif., for producing a key instrument for the *Minuteman* missile guidance system. Subcontract from **North American Aviation, Inc.'s Autonetics Div.**

ARMY

$76,921,772—The Martin Co., Orlando, for continued development of the *Pershing* missile system.

$20,943,120—Hughes Aircraft Co., for four Missile Monitor operational "operations central" systems.

$14,980,526—Raytheon Co., Waltham, Mass. for the *Hawk* program ($7,661,500 for procurement, $3,419,326 for engineering services, $2,399,700 for ground support equipment and $1,500,000 for technical manuals).

$5,273,370—Land-Air, Inc., for data collection services at White Sands Missile Range.

$2,106,800—Esso Research & Engineering Co. for additional funding in continuation of its advanced solid propellant research program.

$1,740,170—R. E. Clarson, Inc., St. Petersburg, for construction of a precision trajectory measuring system at the Air Force Missile Test Center at Cape Canaveral.

$1,352,000—Sperry Rand Corp., Salt Lake City, for research and development on the *Sergeant* missile system.

$1,200,000—Fairchild Engine & Airplane Co., for additional funding on two SD-5 drones.

$1,033,974—Chrysler Corp., for maintenance of *Jupiter* training equipment at the Army Ordnance Guided Missile School, Redstone Arsenal.

$151,044—Firestone Tire & Rubber Co., Los Angeles, for replenishment repair parts for guided missiles.

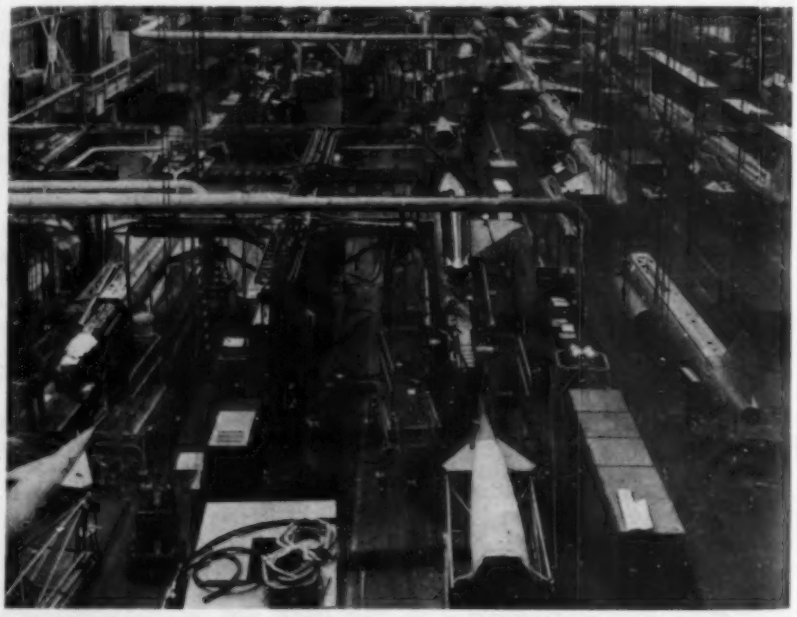
$124,477—Plant Supervision Corp., Plattsburgh, N.Y., for construction of re-entry vehicle facilities.

$93,927—Sperry Rand Corp., Salt Lake City, for *Sergeant* missile ground handling and test equipment. (Two contracts.)

$91,626—Firestone Tire & Rubber Co., Los Angeles, for guided missile ground handling equipment.

$53,340—Norris Thermador Corp., Vernon, Calif., for rocket motor.

$28,588—Aircraft Armaments, Inc., Cockeysville, Md., for design, development and fabrication of *Nike-Zeus* handling equipment.



HOUND DOG air-to-surface missile operational with B-52 bombers is shown in production at North American Aviation. Turbojet-propelled bird has 500-mile range, Mach 1.7 capability.

names in the news

FORREST

MILLER

RABER

ALPERIN

MORRIS

John H. Haughawout: Appointed manager of the computer laboratory's advanced development department at Hughes Aircraft Co.'s ground systems group. Formerly served as manager of an advanced Navy computer project.

J. A. Brustman: Named manager, Electronic Systems Engineering of the Advanced Systems Development Engineering activity for RCA Electronic Data Processing Division. Prior to his appointment, Brustman participated in the design of a computer employing solid-state devices.

Stuart M. Hauser: Former assistant manager of Electro-Optical Systems, Inc.'s Advanced Electronics Division, appointed chief engineer at Electro-Optical Instruments, Inc., a separate company.

Elby Martin: Named marketing manager, Advanced Technologies, in Central Staff Marketing of Texas Instruments, Inc., succeeding **Richard C. Wood,** now manager of the industrial wire department of TI's Metals & Controls subsidiary. Martin was formerly military relations manager in the Semiconductors-Components division.

Melbourne A. Forrest: Vice president of Burns and Roe, Inc., elected to the board of directors. He will be responsible for the firm's project operations in power, nuclear, and industrial fields, as well as defense and aeronautical facilities.

Noel S. Siegel: Assistant to the president of New England Instrument Co., joins Electro-Tec Corp. as manager of marketing development.

Albert J. Morris: Elected president of Radiation at Stanford, the newly formed subsidiary of Radiation Inc. Radiation at Stanford consolidates the former Levinthal Electronic Products, Inc., and the company's former Space Communications Division into one organization. Morris was senior vice president-engineering of the former Levinthal Electronic Products, Inc.

Jack K. Walker: Joins Packard Bell Electronics Corp. as director of product planning for the Defense and Industrial Group. Was formerly director of marketing and engineering at General Precision Equipment Controls, Inc., and director of marketing at Librascope, both subsidiaries of General Precision Equipment Corp.

Robert E. Miller: Formerly director of the Advanced Development Staff, elected to the newly created position of vice president for Advanced Development at Melpar, Inc.

Meade C. Camp: Named manager, Marketing Planning, of the Electronic Data Processing Division of RCA. Was formerly sales manager and manager of customer liaison for the Univac Division of Sperry Rand.

Samuel Raber: Joins the engineering staff of Dorne & Margolin, Inc., as Section Head of the Circuit Group. Was formerly associated with Fairchild Astronics Division as a development specialist in the research division.

Roger W. Fischer and **William H. Smith:** Appointed engineering manager and marketing sales manager, respectively, for Undersea Technology at Avien, Inc.

Robert C. Dunlap, Jr.: Elected vice president of Texas Instruments Inc., succeeding **Fred J. Agnich,** who will continue as a member of the TI board of directors. Dunlap will be operating head of the company's geosciences activities and will continue to serve as president of Geophysical Service Inc., TI's wholly owned exploration subsidiary.

Harold A. Wheeler: Vice president and director of Hazeltine Corp. and president of Wheeler Laboratories, Inc., appointed to the Department of Defense Advisory Group on Radar.

Frank E. Moddocks: Joins the engineering office of Arthur D. Little, Inc., as a senior member of the business development staff. Was previously at the firm's headquarters in Cambridge, Mass., serving as a senior engineer in charge of a project to develop a fuel tank inerting and pressurization system for the B-70 "triplesonic" bomber.

Clifford F. Abt: Assistant research manager, promoted to manager of the Research Department, Arma Division of American Bosch Arma Corp., succeeding **Dr. Bernard Litman,** appointed to the division's newly created scientific staff.

Dr. Morton Alperin: Appointed chairman of the board of the recently formed CircuitDyne Corporation. Was formerly technical director and president of Space Systems and Industrial Automation, a subsidiary of Idaho Maryland Industries.

David D. Terwilliger: Named chief engineer of systems at the Precision Products Dept. of Nortronics. Prior to joining the firm, he was chief electomechanical engineer for Aircraft Armaments Inc.

W. E. Gregg: Former vice president-technology with Crucible Steel Company of America, appointed vice president-operations, succeeding **J. D. Dickerson,** who has taken over new administrative responsibilities.

Ray W. Sanders: Elevated to the newly created position of director of Satellite and Space Laboratories, Space Electronics Corp. Was formerly manager of the department.

Bernard Reich: Named president of Molecular Electronics, Inc., a subsidiary of Precision Circuits, Inc. Was formerly chief, Circuit Functions Branch of the Solid State Devices Division of the U.S. Army Signal Research and Development Laboratories.

Dr. Thomas H. Johnson: Vice president and general manager of the Research Division of Raytheon Co., elected to the board of directors of Technical Operations, Inc.

Robert E. Bell: Named district sales manager-Army Programs for General Electric Co.'s Heavy Military Electronics Dept., replacing **N. N. McIntyre,** assigned to GE's subsidiary in The Hague.

Charles H. New: Former research engineer with the Boeing Airplane Co., joins E D P Corp. as chief engineer.

'How many have home shelters?'

(Continued from page 41)

ploded their first test atomic device. In 1948 the USSR possessed only a rudimentary strategic air force and no ballistic missiles. In 1948 we did not confront the possibility that one-half of our population would be wiped out by surprise attack.

I believe Mr. Hoegh deludes himself if he believes his agency has educated the people, or even government officials, on what this country faces in the event of war, and what can and must be done about it. A few weeks ago I spoke before the Lake County (Florida) League of Municipalities. My audience consisted of mayors, councilmen, police and fire chiefs, and other municipal executives from a dozen towns. "You people," I beban, "are responsible for the survival of the citizens of Lake County should war come. I know that all of you receive, and read, a great deal of material from Washington on civil defense."

Most of them nodded in agreement.

"Now how many of you," I asked, "have a shelter in your home?"

Not one hand went up.

"And how many of you can tell me the name of the national Director of the Office of Civil and Defense Mobilization?"

Out of the fifty-odd people present, only one raised his hand.

READERS' COMMENTS

IT WAS WITH great interest that I read the article entitled "Kennedy Should Put Civil Defense Under Military" in your Dec. 12 issue and wondered who the author, Pat Frank, was. The short biographical sketch at the end of the article clarified this completely.

This man should stick to writing novels and get out of the propaganda field. He is merely acting as a tool for the militarists in the Pentagon who in essence have established a military dictatorship in the U.S. by exerting their influence in foreign policy, by propagating the cold war for their own selfish interests, by drafting American boys in time of peace, and by spending over $40 billion of the taxpayers' money every year.

These same people, under the direction of Gen. Norstad, are pushing the rearming of West Germany with atomic weapons under the guise of NATO. They have even enlisted outgoing Secretary of State Herter in this venture. They have also succeeded in elevating a former Nazi general, Adolf Heusinger, to chairman of the Permanent Military Committee of NATO. And now they want to directly run our lives by imposing civilian defense regulations over our very existence.

The biggest hoax that the military and people like Pat Frank have perpetrated on the American Public is their claim that there can be an atomic war in which mankind can survive. And yet they spend billions of our dollars for just such an eventuality.

The American Public should know that no amount of atomic shelters can save anyone in this country, or in fact anyone in the whole world. Even if only the existing atomic bombs, H-bombs, and Cobalt bombs held by both the East and West were exploded, radioactivity in its various forms such as Strontium 90 would permeate all existing plant life and in short order life in this world would be non-existent.

People like Pat Frank should be called short in their spreading of the big lie so that the world can start looking for the way to peace. What I am now wondering is who paid Mr. Frank to write this article?

John Savas
Canton, Ohio

CONGRATULATIONS and appreciation for the article on Civil Defense by Pat Frank. The writer particularly appreciates the mission that is suggested for the reserve forces.

A few reservists have pleaded for such a mission for years. The time is now on us when the thought of "mobilizing in the event of a National Emergency" is an obsolete concept. This is the foundation of the law which created the reserve forces after World War I. It served reasonably well for WW II, and less well for Korea. It is not adequate today.

Reserves are the ideal forces for the mission of protecting the internal security of the nation. They have had military training, they are familiar with weapons, they know supply and logistics, and they can take care of people in emergencies. Further, they are ideally dispersed so that no attack can possibly obliterate them.

Organize companies of Army Reserve combat troops served with three troop-carrying aircraft of Air Force Reserve around every airport of the nation that can accept the aircraft, and you have a mobile army that can arrive at any point of trouble within two hours. A few men and rifles in the first post-attack hours can do far more than a thousand the next day.

It will be time to mobilize and go on to other missions after the enemy attack has been resisted, and there is time to count heads to see where the next bit of help is needed.

T. B. Holliday
Colonel, AFRes
Chicago

CONGRATULATIONS on the article "Kennedy Should Put Civil Defense under Military" (M/R, Dec. 12, p. 16) by Pat Frank. Mr. Frank very ably blasts at the complacency that exists in the United States about the dangers of atomic war. This article should be reprinted on the front page of every paper in the United States.

More shelters and fewer swimming pools are what we need.

David W. Johnston
Washington, D.C.

IN EMERGENCY... contaminated eyes are instantly cleansed of dangerous particles and chemicals by *controlled* water streams from HAWS Emergency Eye-Wash Fountains. This "split second safety" before medical aid arrives can mean the difference between temporary eye irritation and permanent eye injury! HAWS will provide emergency facilities best suited for your safety program—minimizing hazards, reducing claims, lowering insurance costs. Get the facts by writing today for illustrated literature!

HAWS EYE-WASH FOUNTAINS

MODEL 7100
(old model 8930)

Basic eye-wash model with enameled iron bowl; quick-opening valve for manual operation; adaptable to treadle operation; chrome plated brass water pressure regulators and twin fountain heads. Wall mounted and pedestal models available.

HAWS DRINKING FAUCET CO.
Since 1909
1443 FOURTH STREET
BERKELEY 10, CALIFORNIA

EXPORT DEPARTMENT: 19 Columbus Avenue, San Francisco 11, California, U.S.A.

Circle No. 14 on Subscriber Service Card.

—when and where—

JANUARY

Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Jan. 9-11.

International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Jan. 9-13.

Symposium on Space Instrumentation, Institute of Radio Engineers, PGSET, Washington, D.C., Jan. 16-17.

American Astronautical Society, Annual Meeting, Sheraton-Dallas Hotel, Dallas, Jan. 16-18.

Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Jan. 17-19.

29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York City, **(Honors Night Dinner** Jan. 24), Jan. 23-25.

1961 Plant Maintenance and Engineering Conference, International Amphitheatre, Chicago, Jan. 23-26.

American Mathematical Society, National Meeting, Willard Hotel, Washington, D.C., Jan. 24-27.

Society of Plastics Engineers, Annual Technical Meeting, Shoreham and Sheraton Park Hotels, Washington, D.C., Jan. 24-27.

American Institute of Electrical Engineers, Winter General Meeting, New York City, Jan. 29-Feb. 3.

American Society for Testing Materials, Committee Week, Netherland Hilton Hotel, Cincinnati, Jan. 30-Feb. 2.

American Physical Society, New Yorker Hotel, New York City, Jan. 31-Feb. 4.

FEBRUARY

Institute of Radio Engineers, PGMIL, Los Angeles, Feb. 1-3.

American Rocket Society, Solid Propellant Rocket Conference, The Hotel Utah, Salt Lake City, Feb. 1-3.

Institute of Radio Engineers, International Solid-State Circuits Conference, 8th Annual Meeting, Sheraton Hotel and University of Pennsylvania, Philadelphia, Feb. 15-17.

American Society for Metals, Albuquerque and Los Alamos Chapters, Recent Developments in Materials for Nuclear Applications, University of New Mexico, Albuquerque, Feb. 16-17.

American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, St. Louis, Feb. 19-23.

Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles, Feb. 26-Mar. 1.

American Institute of Chemical Engineers, National Meeting, Roosevelt Hotel, New Orleans, Feb. 26-Mar. 1.

Association of Iron and Steel Engineers, Los Angeles, Feb. 28-Mar. 2.

Western Joint Computer Conference, Los Angeles, Feb. 28-Mar. 1.

M/R BUSINESS OFFICES

Washington 5, D.C.—1001 Vermont Avenue, NW; STerling 3-5400
Edward D. Muhlfeld, Publisher

New York 17, N.Y.—20 East 46 Street; YUkon 6-3900
Paul B. Kinney, Eastern Advertising Manager
Paul N. Anderson

Los Angeles, California—8929 Wilshire Blvd.; OLeander 5-9161
James W. Clear, Western Advertising Manager
Edwin J. Denker, Jr.

Detroit 2, Michigan—412 Fisher Building; TRinity 5-2555
Kenneth J. Wells

Chicago 2, Illinois—139 N. Clark St.; Central 6-5804
R. Lenn Franke

Dallas 24, Texas—202 Wynnewood Professional Building
John L. Hathaway

Miami, Florida—208 Almeria Ave., Coral Gables
Richard D. Hager

London, W.1, England—28 Bruton Street; Grosvenor 8356
Norall and Hart

Geneva, Switzerland—10 Rue Grenus; Geneva 321044

Paris, France—11 Rue Condorcet; TRU 15-39

Frankfurt/Main, West Germany—Friedrich-Ebert-Anlage 3

EMPLOYMENT

MECHANICAL ENGINEER

Amcel Propulsion Inc., a growing organization located in a mountain resort area, has an opening for a mechanical engineer preferably with 3 to 5 years experience of design and prototype follow through of explosive actuating or gas generating.

Write or call Dr. L. R. Rothstein

AMCEL PROPULSION INC.
P. O. Box 3049 **ALpine 3-6464**
Asheville, N. C.
A subsidiary of Celanese Corporation of America

CLASSIFIED

AN FITTINGS & HARDWARE
Stainless, Aluminum, Brass, Steel. All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—Quicker service. Send for free wall charts showing complete line of AN & MS fittings and hardware. We also machine parts to your own special print.
COLLINS ENGINEERING CORPORATION
1050 Washington Blvd., Culver City, California

FASTENERS FOR AIRCRAFT AND MISSILES
Immediate Delivery—AN—N.A.S.—M.S.—6 Digit
CERTIFIED TO GOVERNMENT SPECIFICATIONS
Bolts—Nuts—Rivets—Screws—Studs—Internal and External Wrenching Bolts—Dowel and Lock Pins
Mercury air parts co., inc.
9310 West Jefferson Blvd., Culver City, Calif.
Telephone—UPton 0-5923—Teletype—CVR CY 4138
TOUGH SPECIALS 10 DAY DELIVERY
MANUFACTURERS OF PRECISION HARDWARE

HI-FIDELITY components, tape recorders, and tapes at wholesale prices. Send for FREE catalogue. **Carston 125-RM, East 88, N.Y.C. 28.**

Advertisers' Index

Aerospace Corp. 19
Agency—Gaynor & Ducas, Inc.

Autonetics, a Div. of North American Aviation, Inc. . . 35
Agency—Batten, Barton, Durstine & Osborn, Inc.

Avco Corp. 51
Agency—Benton & Bowles, Inc.

Avnet Electronics Corp. 22
Agency—Dale & Finkels, Inc.

Cannon Electric Co. 8
Agency—Anderson-McConnell Adv. Agency, Inc.

Delco Radio, Div.-General Motors Corp. 31
Agency—Campbell-Ewald Co.

Douglas Aircraft Co., Inc. . . 20
Agency—J. Walter Thompson Co.

C. P. Goerz American Optical Co. 7
Agency—R. E. McGuire Assoc., Inc.

Haws Drinking Faucet Co. . . 48
Agency—Pacific Adv. Staff

Hoffman Electronics Corp., Semiconductor Div. 52
Agency—Allen, Dorsey, & Hatfield, Inc.

Kearfott Co., Sub.-General Precision Equipment Corp. 41
Agency—Gaynor & Ducas, Inc.

Kollmorgen Corp. 6
Agency—Wilson, Haight & Welch, Inc.

Mimx Corp. 45
Agency—The Martin R Klitten Co., Inc.

Monsanto Chemical Co. . . . 2, 3, 4
Agency—Gardner Advertising Co.

Propellex Chemical Corp. . . . 39
Agency—Al Maescher Adv.

Radio Corp. of America, Industrial Electronic Products 26, 27
Agency—Al Paul Lefton Co., Inc.

Reinforced Plastics, Dept. of Raybestos Manhattan, Inc. 46
Agency—Gray & Rogers, Adv.

System Development Corp. . . 10
Agency—Fuller & Smith & Ross, Inc.

EMPLOYMENT

Amcel Propulsion Inc., a Sub. of Celanese Corp. of America 49

editorial . . .

Military Dogma Fades Slowly, Too

IT IS DOUBTFUL if the proposed reorganization of the U.S. defense structure, during the next year at least, will be much more than the administrative changes which can be accomplished by executive action.

This will be a great disappointment to those who would like to see some of the layers of indecision and inaction swept out of the Pentagon corridors.

The important thing is that the plan presented to Mr. Kennedy to revamp the U.S. military establishes a goal. There is little conviction in the minds of even those who will oppose the Symington plan most bitterly, that our defense structure is the best it could be, or that its design permits it to cope with the military needs of the times.

It is axiomatic in military history that the defending forces in any major war fight with the same organization and the same tactics they employed at the conclusion of the last major war.

It is also historically axiomatic that these defending forces get the daylights kicked out of them until they modernize their organization and tactics.

The French began World War I with the same artillery barrages and cavalry charges which had conquered them at Sedan in 1870.

The allies began World War II with the trench warfare concept which had prevailed in 1919. (The Germans had mechanized and the French again lost their war at Sedan)

In those conflicts there was time for change, time to change from a peacetime military into a wartime military. The cost was high in lives and cities but after all, the world was accustomed to this. Men had been dying and cities falling to the rigid military mind since the first written lines of history.

But these are different days and different times, even though only 15 years and a few months have passed since Japan surrendered to the only two atomic weapons ever dropped in combat.

This is the day when atom-tipped missiles fly 5000 miles in thirty minutes, when bombers carry 20-megaton loads, when satellite launchings have become commonplace.

It is also the day when the United States has solid commitments to go to war in strange and remote places in defense of tenuous democracy, or at least to prevent the spread of communism by force.

DO WE REALLY have a mobile strike force with what components, land, sea and air are needed, ready to take off for Laos on hours' notice? Under one command and not three?

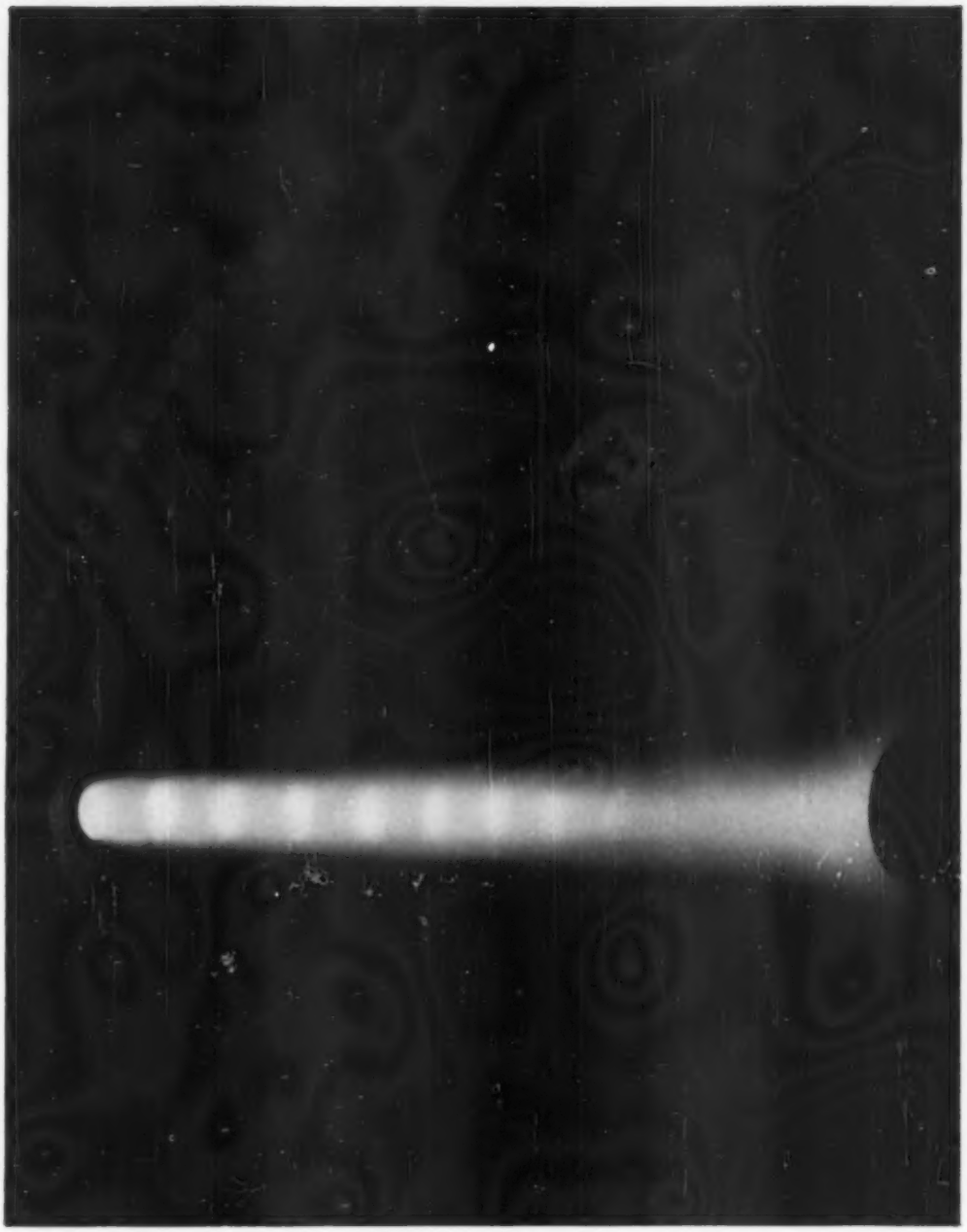
Are we strategically unified to provide the greatest possible retaliatory threat? Are we prepared to take the first blow and still fight back?

Probably not, in any instance. And it is doubtful if we shall be quickly. The rigidity of the military mind has its counterpart in the civilian, particularly if the civilian happens to wear four stars in Congress.

So, the change will come slowly. The Symington plan may not be the best and it may not be acceptable to those with the power to disapprove modernization. It does, however, provide a goal and this—again—is perhaps most important.

The new team which moves into the Administration and the Pentagon can do a great deal by executive order and clear-cut decision if the team is so determined.

Clarke Newlon



Tailoring new re-entry materials with a white-hot needle. This is a 10-megawatt arc jet "needle." Avco uses it to test heat-shield materials under simulated re-entry conditions. Avco has capabilities for developing new materials to meet whatever thermal environmental conditions may be encountered by a re-entering nose cone, satellite or space probe. Examples: Avcoite, reinforced-quartz protector of the first ICBM nose cone recovered after flight . . . Avcoat, special all-plastic formulation which can be cast, sprayed or painted on. Other exotic materials are on the way as Avco tailors new ceramic-plastic composites to surmount re-entry obstacles.

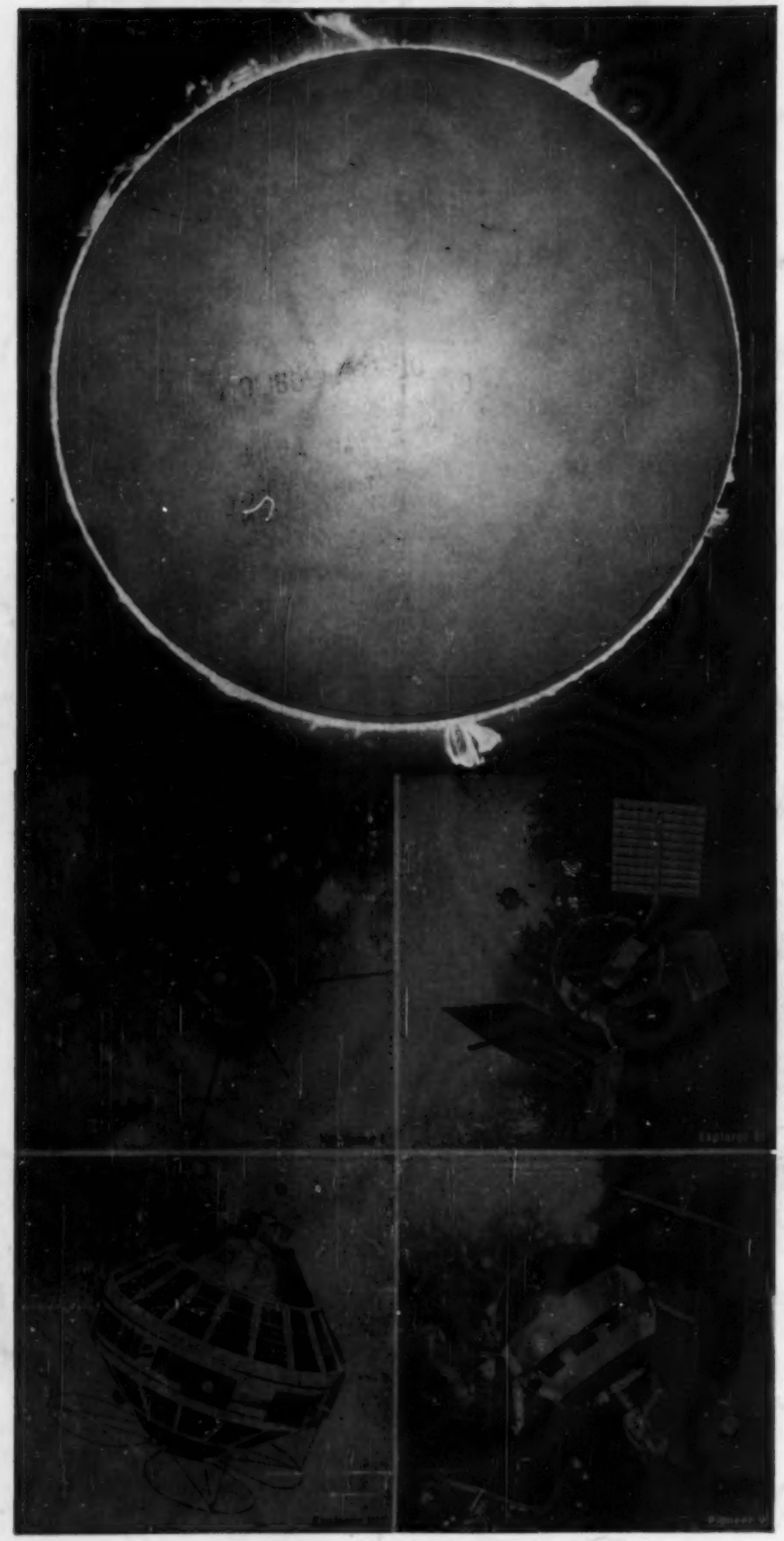
UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS . . . WRITE AVCO TODAY.

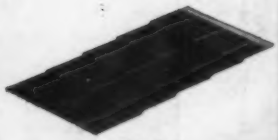
Avco

AVCO CORPORATION, 750 THIRD AVENUE, NEW YORK 17, NEW YORK

1961

Hoffman solar-power series.





Solar-Shingle®†

MORE THAN 54,000 HOURS OF RELIABLE OPERATION IN SPACE

— that's the record of Hoffman silicon solar cells in four of our nation's satellites

Specify Hoffman solar-cell assemblies a you specify space-proven reliability. achieve this kind of solar energy perfor ance, Hoffman conducts every operati from raw silicon processing to finish panel assembly, under one roof. ■ For dependable, custom-engineered solution your problem in solar-power systems, c sult your Hoffman sales engineer. Deta available on Data Sheet 126-660S.

†A Patented Device (U.S. Patent No. 2,938,

Hoffman

ELECTRONICS CORPORATION

Semiconductor Division

1001 Arden Drive, El Monte, California
TWX: El Monte 9735
Plants: El Monte, California and Evanston, Illi

Circle No. 7 on Subscriber Service Card.

ies.

S
RATION

ord
solar
f
ites

mblies
ability.
ty perfor
operati
to finish
f. ■ For
solution
stems, c
eer. Deta
OS.

o. 2,938,9

an
e
N
sion
alifornia
ston, Mas